

Highway Safety Improvement Program

Benefit-Cost Tool DRAFT Users Manual

Illinois Department of Transportation

December 2008

Contents

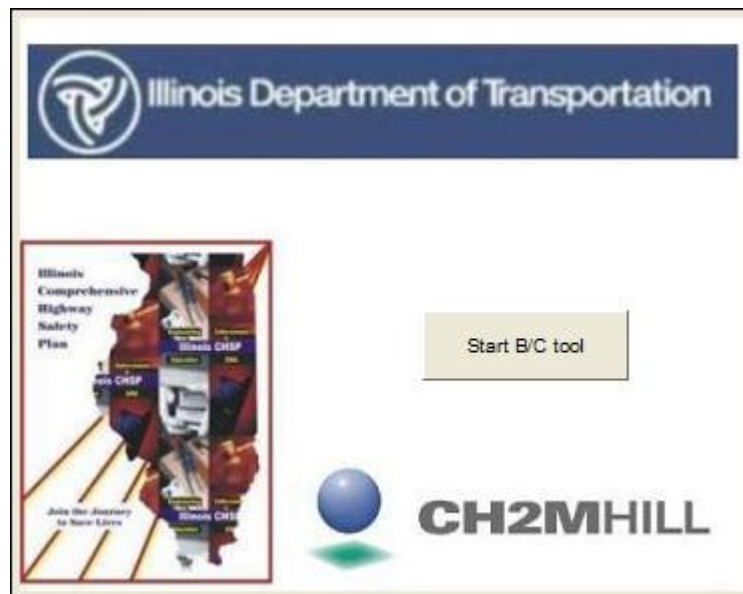
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1.0 Introduction

Benefit-cost analysis (BCA) is one of the tools used to determine if a project is appropriate for receipt of Highway Safety Improvement (HSIP) funding support. An approved project should have a safety focus and result in an improvement which will likely reduce the number of fatal and/or severe injury crashes. To facilitate the process, the Illinois Department of Transportation developed a BCA tool to aid in quick and accurate evaluation of highway improvement proposals.

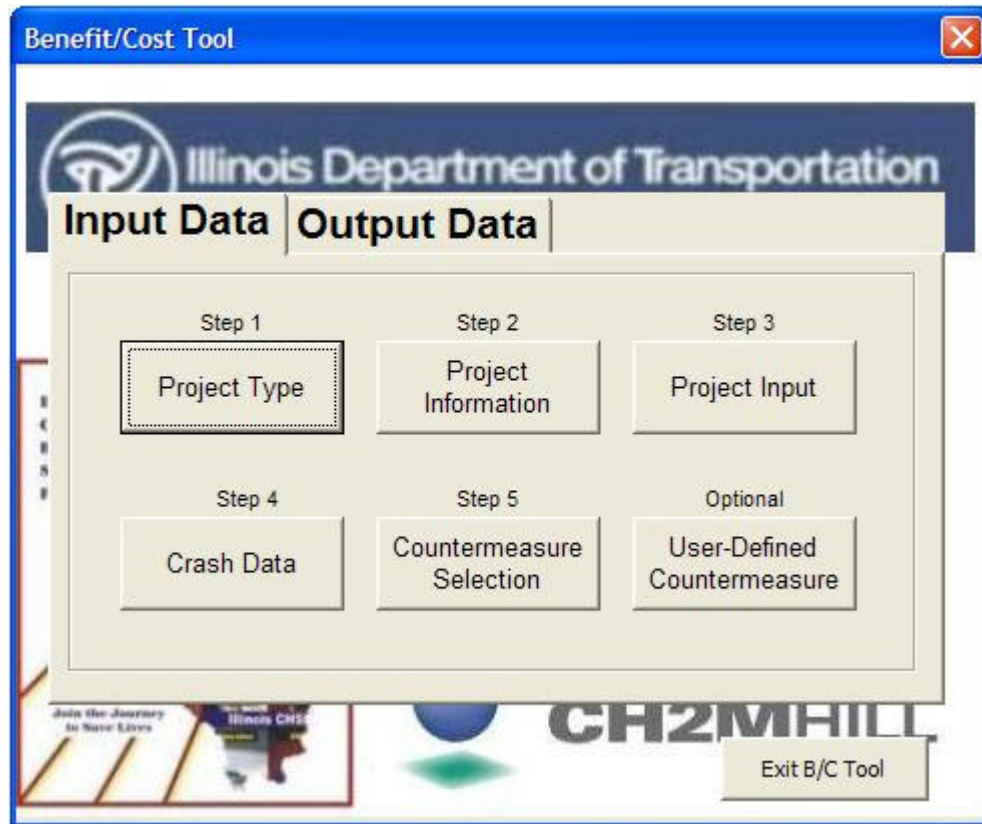
This manual provides step-by-step instructions for using the BCA tool developed by IDOT. It also provides several example scenarios to assist the user in understanding use of the tool in project development. The final section of this document provides guidelines for appropriate benefit-cost values.

2.0 Step-by-Step Instructions



The image above shows the opening page of the B/C tool.

STEP 1: Start by pressing the **Start B/C Tool** button.



The main menu will open after selecting start. The main menu has two tabs located at the top of the screen. One is for entering Input Data and the other for obtaining Output Data.

STEP 2: Select the **Input Data** tab if necessary. This is the default and should have been open when starting the tool.

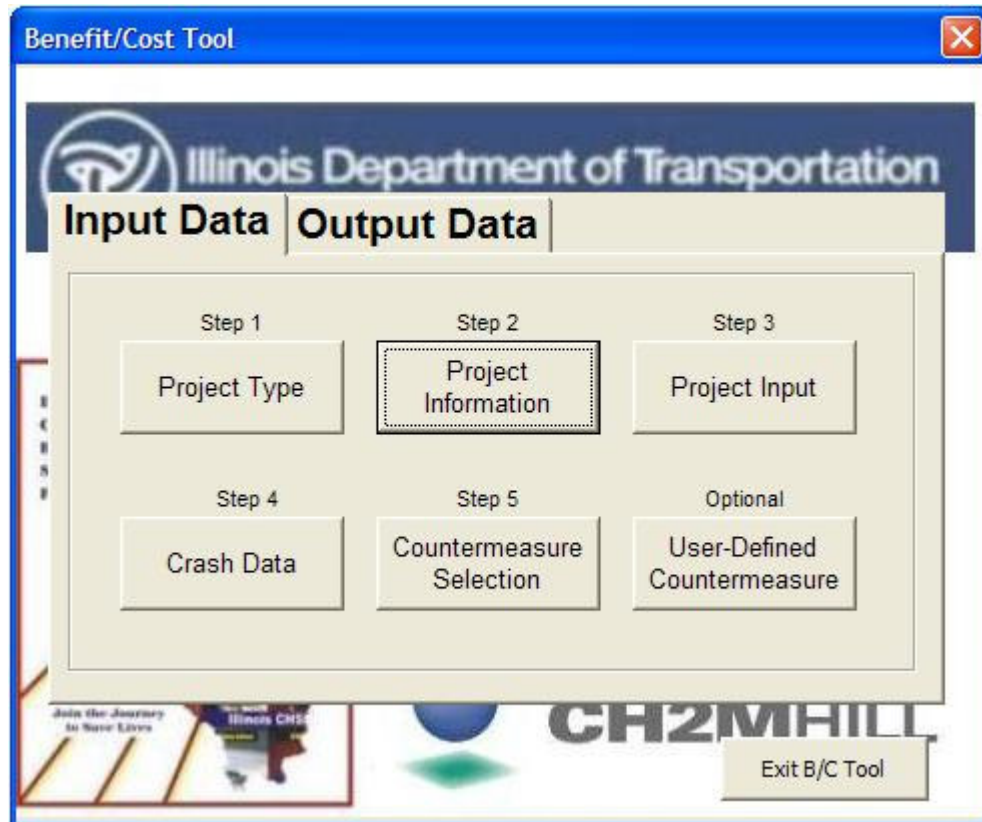
The input tab shows a series of steps. It is recommended that you follow the sequence of input steps as shown in the pop-up window; however you can come back to buttons to revise the data as needed.

STEP 3: Select the button labeled **Project Type**

The screenshot shows a software window titled "Project type selection". It contains three groups of radio buttons for selection. The first group, "Project Type", has "Intersection" selected. The second group, "Traffic Control", has "Signalized" selected. The third group, "Segment Type", has "Urban" selected. A "Return to Main" button is located at the bottom right of the window.

The Project Type Selection window will appear.

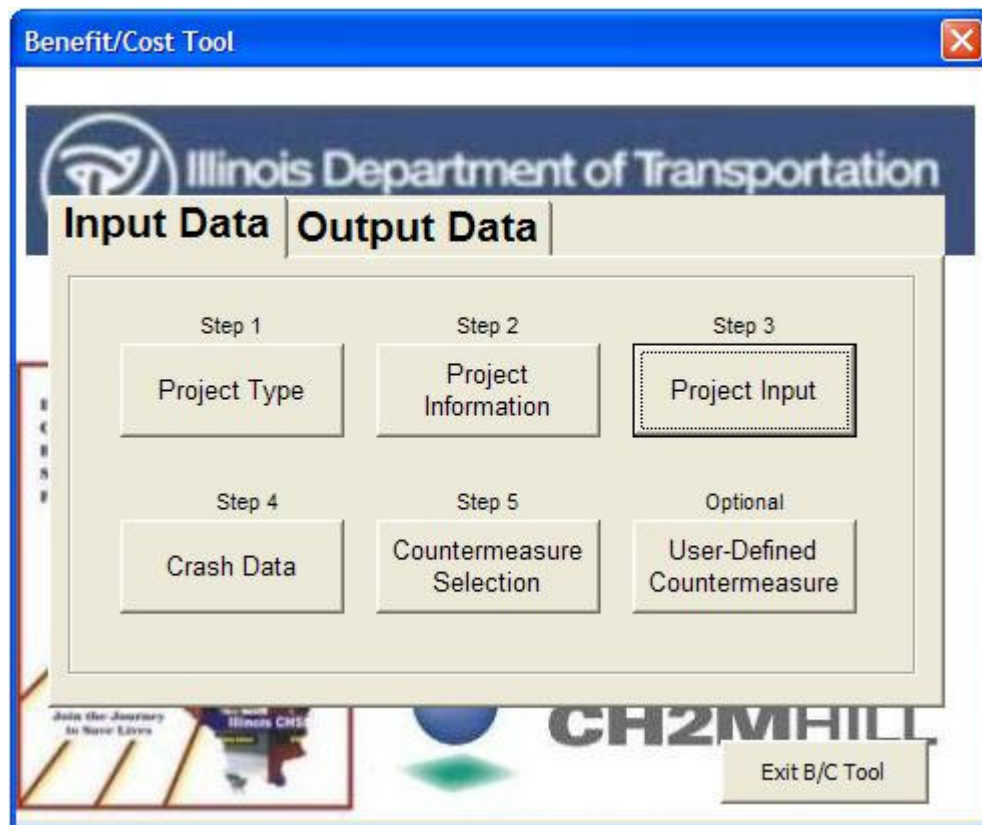
STEP 4: Select project type by clicking on the circle next to **Intersection** or **Segment** depending on the type of project you are analyzing. If **Intersection** is selected you will be given the option of **Signalized** or **Unsignalized**. If **Segment** is selected you will be given the option of **Urban** or **Rural**. Make the selection by clicking on the circle next to the appropriate category. When complete click on the **Return to Main** button to return to the main input window.



STEP 5: On the main menu, select the button labeled **Project Information**.

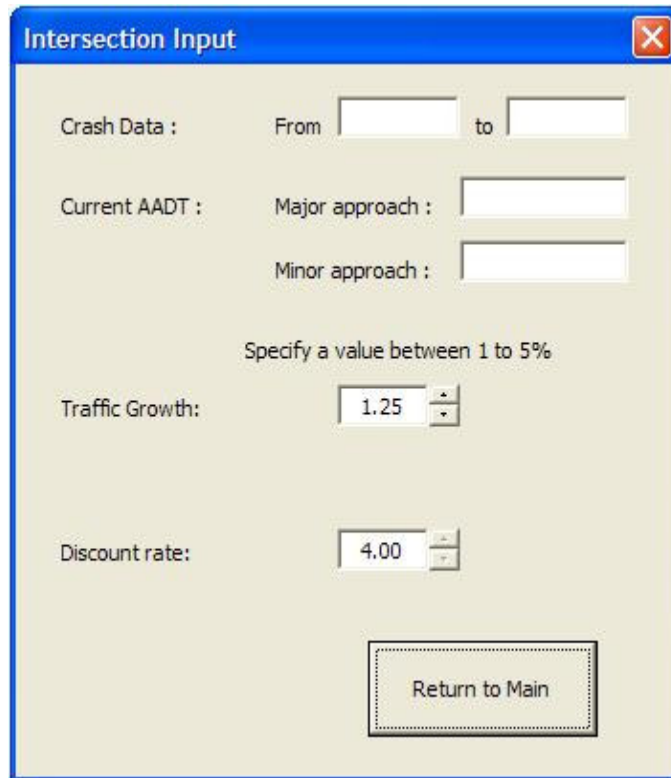
The Project Information window will open as shown above.

STEP 6: Complete the information in the boxes shown. For segments enter either key route or marked route and the beginning milepost station. Key Route refers to the Illinois Roadway Information System (IRIS) terminology and it is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For the **Location** field enter a description like “Maple Road and Oak Street” for an intersection or “Maple Road between Oak Street and Walnut Street” for a segment. When all fields have been completed, click on **Return to Main**.



The main menu will re-open.

STEP 7: Select the button labeled **Project Input**.



Intersection Input

Crash Data : From to

Current AADT : Major approach :

Minor approach :

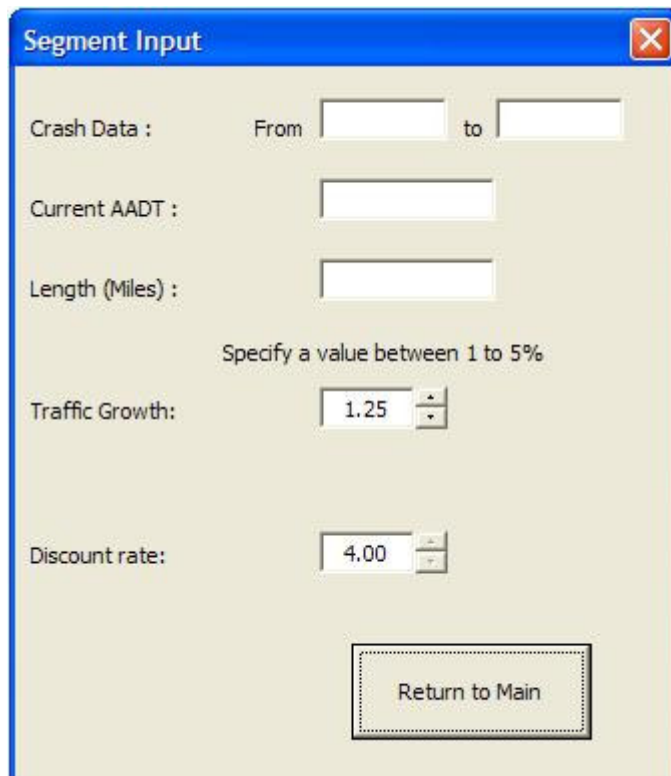
Specify a value between 1 to 5%

Traffic Growth:

Discount rate:

[Return to Main](#)

If intersection project type was selected, the project input window shown above will appear.



Segment Input

Crash Data : From to

Current AADT :

Length (Miles) :

Specify a value between 1 to 5%

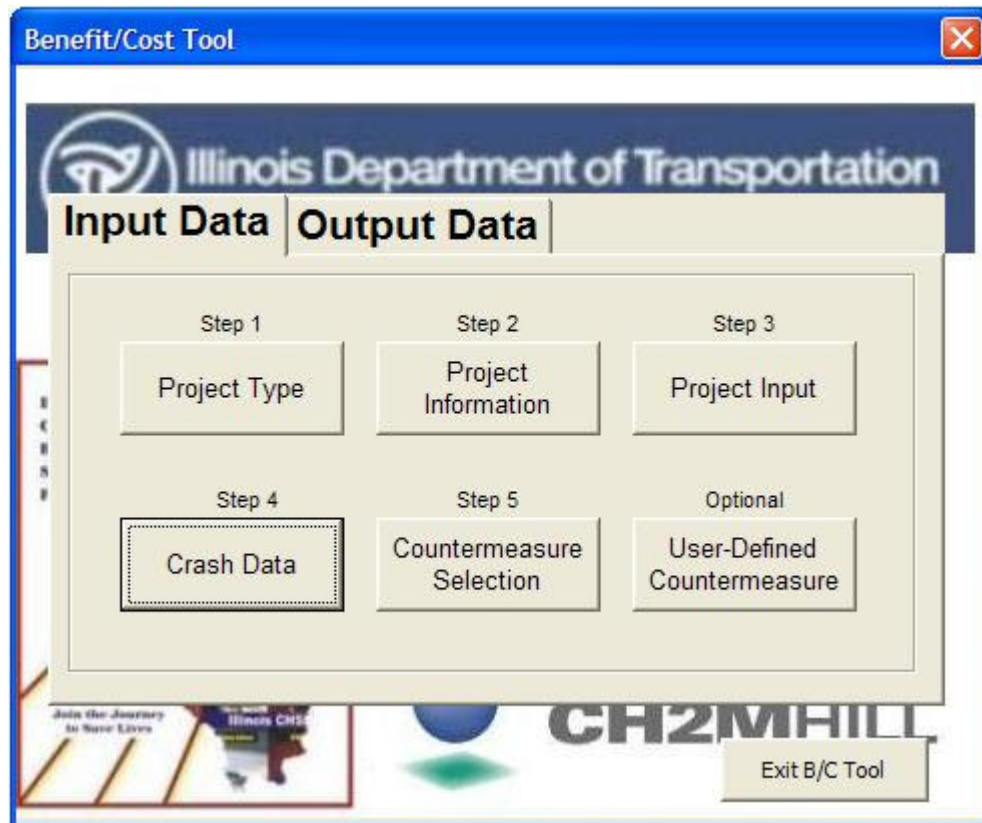
Traffic Growth:

Discount rate:

[Return to Main](#)

If segment project type was selected, the above project input window will appear.

STEP 8: Input the information requested in the fields of either the **Intersection Input** or **Segment Input** window. For **Crash Data**, enter the period for which crash data is available (for example, From 2001 to 2005). Enter the **Current AADT**(Average Annual Daily Traffic), length of project if applicable, and the annual traffic growth. The annual **traffic growth** should be a number between 1 and 5. If no selection is made, the default value of 1.25 will be shown. If the user enters a value less than one, it is assumed that the traffic growth is declining. The **discount rate** cannot be modified from the default value of 4.00. When complete with all fields click on **Return to Main**.



The main menu will re-open.

STEP 9: Select the button labeled **Crash Data**.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

☒ Crash Severity Distribution by Crash type

☐ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : Do you have wet pavement crashes? :

☐ Yes ☐ Yes

Enter Crash Data Return to Main

The above window will open.

STEP 10: If crash type and crash severity data are available, select **Crash Severity Distribution by Crash Type** by clicking on the circle next to the text. If crash type data are not available, select the **Aggregate Crash Severity Distribution** category by clicking on the circle next to the text. In most cases crash type data will be available. This is the preferred condition since countermeasures are applied to reduce particular crash types.

If **Crash Severity Distribution by Crash Type** is selected, follow STEPs 11A to 13A. If **Aggregate Crash Severity Distribution** is selected, skip to STEP 11B and follow to STEP 12B.

The screenshot shows a software window titled "Crash Data" with a blue title bar and a red close button. The window contains two main sections. The first section, "Crash Data Availability", asks "What type of crash data do you have available? :". It has two radio button options: "Crash Severity Distribution by Crash type" (which is selected) and "Aggregate Crash Severity Distribution". The second section, "Crash Data - Condition Related", contains two questions: "Do you have night time crashes? :" and "Do you have wet pavement crashes? :". Each question has a checkbox labeled "Yes". Both checkboxes are checked. At the bottom of the window is a button labeled "Enter Crash Data".

When **Crash Severity Distribution by Crash Type** is selected **Crash Data - Condition Related** will highlight as shown in the above window.

STEP 11A: If there are night time crashes in your data set, click on the **Yes** box following the question, **Do you have night time crashes?** If there are wet pavement crashes in your data set, click on the **Yes** box following the question, **Do you have wet pavement crashes?**

See page 27 to learn more about obtaining crash information from the crash reports.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																	
2		Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalogist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train
3		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PAV	RE	RT	SSD	SOD	T	TR
4	Fatal Crashes																	
5	A-Injurg Crashes																	
6	B-Injurg Crashes																	
7	C-Injurg Crashes																	
8	PDO Crashes																	
9																		
10																		
11																		
12																		
13																		
14																		
15																		

After selecting “Enter Crash Data,” the input box, “Intersection Crash Severity by Crash Type for Analysis Period” will appear.

STEP 13A: Enter the crash data for the analysis period by crash type and severity. Individual crashes should only be entered once based on the first event of the crash. When complete, select the **Return to Main** button and continue with STEP 14. Be sure to “enter” the last data entered by using the **Enter** key or clicking another cell before attempting to click the **Return to Main** button.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

☐ Crash Severity Distribution by Crash type

☒ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : ☐ Yes

Do you have wet pavement crashes? : ☐ Yes

Enter Crash Data

STEP 11B: If crash type by severity is not available, click on the circle next to **Aggregate Crash Severity Distribution** in the Crash Data screen. Then click on **Enter Crash Data** to enter aggregate crashes by severity. It is important to notice that the user will not be able to input night time or wet pavement crashes with an aggregate crash severity distribution. If **Aggregate Crash Severity Distribution** is selected, the **Crash Data - Condition Related** frame will not become available as is shown in the figure above.

	A	B	C	D
1	INTERSECTION AGGREGATE CRASH SEVERITY DISTRIBUTION			
2				
3		All Crashes		
4	<i>Crash Severity</i>	<i>ALL</i>		
5	Fatal Crashes			
6	A-Injury Crashes			
7	B-Injury Crashes			
8	C-Injury Crashes			
9	PDO Crashes			
10				
11				
12	Return to Main			
13				
14				
15				

After selecting **Enter Crash Data** the input box shown above will appear. The box shown is for intersections, but a similar table will appear for segments.

STEP 12B: Enter the number of crashes by severity that have occurred during the analysis period. When complete, select the **Return to Main** button. Be sure to “enter” the last data entered by using the Enter key or clicking another cell before attempting to click the Return to Main button.

The screenshot shows the 'Benefit/Cost Tool' window with the 'Input Data' tab selected. The interface displays a sequence of steps for data entry:

- Step 1:** Project Type
- Step 2:** Project Information
- Step 3:** Project Input
- Step 4:** Crash Data
- Step 5:** Countermeasure Selection (highlighted with a dashed border)
- Optional:** User-Defined Countermeasure

At the bottom right, there is an 'Exit B/C Tool' button. The background features the Illinois Department of Transportation logo and a CH2M HILL logo.

The main menu will re-open.

STEP 14: Select the button labeled **Countermeasure Selection**.

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CRF *	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life		
<input type="text"/>	0%	0			0	\$0	0		
<input type="text"/>	0%	0			0	\$0	0		
<input type="text"/>	0%	0			0	\$0	0		
<input type="text"/>	0%	0			0	\$0	0		
<input type="text"/>	0%	0			0	\$0	0		
<input type="text"/>	0%	0			0	\$0	0		

***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).

* CRF = Crash Reduction Factor
 ** EUAC = Estimated Uniform Annual Cost

[Return to Main](#)

If intersection project type was selected, the countermeasure table shown above will appear. If segment project type was selected, a similar countermeasure table will appear.

STEP 15: Review the list of countermeasures shown in Table 1 for intersections and Table 2 for segment. Select countermeasures that affect the predominant crash types in the data set for the intersection or segment to be analyzed. It is also recommended that you review the "Desktop Reference for Crash Reduction Factors" published by the USDOT and FHWA on September 2007 for additional countermeasures and current crash reduction factors (CRF). A CRF is a percentage of crash reduction that can be expected for implementing specific countermeasure. For example, if shoulder rumble strips are added to a facility there is an expected thirty percent reduction in the number of fixed object and overturn crashes.

TABLE 1: INTERSECTION COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
1.1 General				
1.1.1 Improvement/Realignment/Reconstruction URBAN	Unit Qnty	15	50%	All
1.1.2 Improvement/Realignment/Reconstruction RURAL	Unit Qnty	15	30%	All
1.2 Pavement				
1.2.1 Widening and Resurfacing or Widening alone	Miles	15	25%	All
1.2.2 Resurfacing alone	Miles	10	-	
1.2.3 De-Slick (formerly known as skidproofing)	Miles	5	45%	WP
1.2.4 Rumble Strips (Shoulder)	Miles	3	30%	FO,OVT-off the road
1.2.5 Rumble Strips (Centerline)	Miles	3	-	
1.2.6 Rumble Strips (Transverse)	Miles	3	25%	All
1.2.7 Channelization	Miles	15	50%	RE,HO,SSD,SOD,LT,FO,O VT,T,RT
1.2.8 Raised Reflective Marker Median	Miles	15	50%	HO,SOD,LT,T,RT
1.2.9 Rumble Strip Median	Miles	10	50%	HO,SOD,LT,T,RT
1.2.10 Thermoplastic or Preformed Tape Median	Miles	3	50%	RE,HO,SSD,SOD,LT,RT,T
1.2.11 Painted Median	Miles	2	50%	RE,HO,SSD,SOD,LT,RT,T
1.2.12 Lane Addition	Unit Qnty	15	50%	RE,SSD, LT,RT,T
1.2.13 Left Turn Lane	Unit Qnty	15	25%	Each leg w/added Left turn, RE,SSD,SOD,LT
1.2.14 Right Turn Lane	Unit Qnty	15	25%	Each leg w/added Right turn, RE,SSD,RT
1.2.15 Bidirectional Left Turn Lane	Unit Qnty	15	50%	RE,HO,SSD,SOD,LT
1.2.16 Left Turn Acceleration Lane	Unit Qnty	15	50%	RE,SOD,SSD,AG,LT
1.2.17 Right Turn Acceleration Lane	Unit Qnty	15	50%	RE,SSD,RT
1.2.18 Deceleration Lane	Unit Qnty	15	50%	RE,SSD,RT
1.2.19 One-Way Couple	Unit Qnty	15	50%	All
1.2.20 Install Roundabout	Unit Qnty	15	60%	All
1.2.21 Install Passing Lane	Unit Qnty	15	25%	All
1.2.22 Increase Width of Paved Shoulder	Miles	10	10%	All
1.2.23 Increase Lane Width	Miles	15	10%	All

TABLE 1: INTERSECTION COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
1.3 Signing				
1.3.1 Modernization	Unit Qnty	6	25%	All
1.3.2 Installation	Unit Qnty	6	40%	All
1.3.3 Speed Signing	Unit Qnty	6	40%	All
1.3.4 Advance Warning Signs	Unit Qnty	6	25%	All
1.3.5 Street Name Signs	Unit Qnty	6	25%	All
1.3.6 Four Way Stop	Unit Qnty	5	50%	All
1.3.7 Minor Leg Stop	Unit Qnty	5	40%	AG,LT,RT,T
1.3.8 Yield Sign	Unit Qnty	5	40%	AG,LT,RT,T
1.3.9 Changeable Message Signs	Unit Qnty	6	10%	All
1.3.10 Delineators	Unit Qnty	4	40%	All
1.3.11 Overhead Sign Truss	Unit Qnty	15	40%	RE,SOD
1.4 Signalization				
1.4.1 Modernization	Unit Qnty	10	25%	PD,FO,RE,SSD,SOD,AG,L T,RT,T
1.4.2 Install Traffic Signals	Unit Qnty	15	23%,- 38%	23% All Other. -38% RE. 67% RAG
1.4.3 Relocation of Signal Supports	Unit Qnty	15	25%	FO
1.4.4 Advance Warning with Flasher	Unit Qnty	10	15%	OVT,FO,RE,SSD,SOD,AG, LT,RT,T
1.4.5 Red/Yellow Flashing Beacon	Unit Qnty	10	NR	Not recommended.
1.4.6 Red Flashing Beacon	Unit Qnty	10	45%	AG
1.4.7 Add Left Turn Phase with Left Turn Lane	Unit Qnty	10	35%	All
1.4.8 Add Left Turn Phase without Left Turn Lane	Unit Qnty	10	25%	All
1.4.9 Phase Adjustment	Unit Qnty	10	25%	All
1.4.10 Increase to 12 Inch Lens	Unit Qnty	10	25%	All
1.4.11 Add Traffic Actuation	Unit Qnty	10	25%	RE,AG,LT,RT,T
1.4.12 Time Lane Control	Unit Qnty	10	25%	HO,SOD
1.4.13 Optical Programmed	Unit Qnty	10	25%	RE,AG,LT,RT,T
1.4.14 Add Pedestrian Controls	Unit Qnty	10	25%	PD,PDC
1.4.15 Add Mast Arms and Signal Head per Lane	Unit Qnty	15	25%	RE,AG,LT,RT,T
1.4.16 Safety Lighting	Unit Qnty	15	50%	50% NGT

TABLE 1: INTERSECTION COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
1.4.17 Install Automated Enforcement of Red Light Violations	Unit Qty	10	25%	AG, -15% RE
1.4.18 User defined 01				
1.4.19 User defined 02				
1.4.20 User defined 03				

TABLE 2: SEGMENT COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
2.1 Pavement Treatments				
2.1.1 Widening and Resurfacing or Widening alone	Miles	15	25%	All
2.1.2 Resurfacing alone	Miles	10	0%	No CRF identified
2.1.3 De-Slick (formerly known as skidproofing)	Miles	5	45%	WP
2.1.4 Rumble Strips (Shoulder)	Miles	3	30%	FO,OVT
2.1.5 Rumble Strips (Centerline)	Miles	3	20%	HO,SOD
2.2 Pavement Marking				
2.2.1 General Pavement Marking	Miles	1	30%	All
2.2.2 Raised Reflective Markers	Miles	4	30%	NGT on tangent sections. For curves, see table 1 of the HSIP Policy.
2.3 Railroad Crossing				
2.3.1 Modification	Miles	15	50%	TR,FO,RE,OVT
2.3.2 Gates	Miles	15	60%	TR,FO,RE,OVT
2.3.3 Crossbucks	Miles	15	60%	TR,FO,OVT
2.3.4 Flashing lights	Unit Qty	15	60%	TR,FO,RE,OVT
2.3.5 Flashing Beacons	Unit Qty	15	60%	TR,FO,RE,OVT
2.3.6 Warning Bells	Unit Qty	15	50%	TR
2.3.7 Pavement Markings	Miles	2	30%	TR,RE,FO,OVT
2.3.8 Warning Signs - Standard	Unit Qty	2	40%	TR,FO,RE,OVT

TABLE 2: SEGMENT COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
2.1 Pavement Treatments				
2.1.1 Widening and Resurfacing or Widening alone	Miles	15	25%	All
2.3.9 Warning Signs - Special	Unit Qnty	5	40%	TR,FO,RE,OVT
2.3.10 Delineators	Miles	4	40%	TR,FO,OVT
2.3.11 Safety Lighting	Unit Qnty	15	50%	TR,FO,RE,OVT
2.3.12 Resurfacing	Miles	10	25%	TR,FO,RE,OVT
2.3.13 Grade Separation	Unit Qnty	20	100%	All
2.3.14 Removal (specify which type of removal)	Miles	20	50%	All
2.4 Bridge				
2.4.1 General Repair	Miles	10	15%	PKV, HO,SOD,SSD,FO,OVT
2.4.2 Widen/Resurface	Miles	15	15%	FO,HO,SOD,SSD,OVT
2.4.3 Widening	Miles	15	15%	FO,HO,SOD,SSD,OVT
2.4.4 De-Slick	Miles	5	45%	WP
2.4.5 Grooving	Miles	7	45%	WP
2.4.6 Frost/Ice Detectors - Sign	Unit Qnty	10	25%	FO,HO,SOD,SSD,OVT
2.4.7 Frost/Ice Detectors - Radio	Unit Qnty	10	25%	PKV, HO,SOD,SSD,FO,OVT
2.4.8 Guardrail	Miles	10	15%	FO,OVT
2.4.9 Separation between Pedestrians/Traffic	Miles	15	95%	PD,PDC,FO,OVT
2.4.10 Safety Lighting	Unit Qnty	15	50%	NGT
2.4.11 Delineators	Miles	4	15%	FO,OVT
2.4.12 Impact Attenuators	Unit Qnty	3	70%	FO,OVT
2.4.13 Reconstruction	Miles	20	50%	FO,HO,SOD,SSD,OVT
2.5 Curves				
2.5.1 Realignment/Reconstruction URBAN	Miles	15	35%	OVT,FO,HO,SSD,SOD
2.5.2 Superelevation	Miles	15		Variable, see table 2 in the HSIP Policy.
2.5.3 Daylighting	Miles	15	30%	OVT,FO,HO,SSD,SOD
2.5.4 Widening and Resurfacing or Widening alone	Miles	15	25%	All
2.5.5 De-Slick (formerly known as	Miles	5	45%	WP

TABLE 2: SEGMENT COUNTERMEASURES

COUNTERMEASURES	Unit	Service Life	CRF	Crash Type Affected
2.1 Pavement Treatments				
2.1.1 Widening and Resurfacing or Widening alone skidproofing)	Miles	15	25%	All
2.5.6 Guardrail	Miles	10	40%	FO,OVT
2.5.7 Advance Warning Sign	Unit Qnty	5	20%	All
2.5.8 Chevrons or Delineators	Unit Qnty	4	40%	OVT,HO,SOD,FO
2.5.9 Relocation	Unit Qnty	15	45%	All
2.6 Roadside Safety				
2.6.1 General/Fixed Obstacle Removal	Unit Qnty	20	50%	FO,OVT
2.6.2 Curb Parking Removal	Unit Qnty	20	50%	PKV,RE,FO,OVT
2.6.3 Guardrail	Miles	10	15%	FO,OVT
2.6.4 Utility Adjustment	Miles	15	45%	FO,OVT involving utility hazards
2.6.5 Drainage Improvement	Miles	10	10%	All
2.6.7 Shoulder Improvement	Miles	5	10%	FO,OVT
2.6.8 Impact Attenuators	Miles	3	70%	FO,OVT
2.6.9 Glare Shields	Miles	10	15%	SSD,AG,FO,OVT
2.6.10 Fencing	Miles	10	15%	All
2.7 Other				
2.7.1 Turnouts (Mailbox or other)	Miles	15	50%	Entering or exiting vehicles from shoulder area
2.7.2 Ramp Improvement	Miles	15		Variable. See table in the HSIP Policy.
2.7.3 User defined 01				
2.7.4 User defined 02				
2.7.5 User defined 03				

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CRF *	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life		
1.0 Intersection Locations:	0%	0			0	\$0	0		
1.1 General	0%	0			0	\$0	0		
1.1.1 Improvement/Realignment/Reconstruction URBAN	0%	0			0	\$0	0		
1.1.2 Improvement/Realignment/Reconstruction RURAL	0%	0			0	\$0	0		
1.2 Pavement	0%	0			0	\$0	0		
1.2.1 Widening and Resurfacing or Widening alone	0%	0			0	\$0	0		
1.2.2 Resurfacing alone	0%	0			0	\$0	0		
1.2.3 De-Stick (formerly known as skidproofing)	0%	0			0	\$0	0		
1.2.4 Rumble Strips (Shoulder)	0%	0			0	\$0	0		
1.2.5 Rumble Strips (Centerline)	0%	0			0	\$0	0		
1.2.6 Rumble Strips (Transverse)	0%	0			0	\$0	0		
1.2.7 Channelization									
1.2.8 Raised Reflective Marker Median									
1.2.9 Rumble Strip Median									
1.2.10 Thermoplastic or Preformed Tape Median									
1.2.11 Painted Median									
1.2.12 Lane Addition									
1.2.13 Left Turn Lane									
1.2.14 Right Turn Lane									
1.2.15 Bidirectional Left Turn Lane									
1.2.16 Left Turn Acceleration Lane									
1.2.17 Right Turn Acceleration Lane									
1.2.18 Deceleration Lane									
1.2.19 One-Way Couple									

YES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use $\frac{B}{C}$).

is selected from the drop down menus***

are selected

Update the "Quantity" for each countermeasure selected for cost calculations

Return to Main

STEP 16: Select the appropriate countermeasures using the pull-down menu under the countermeasure tab. The tool allows for selection and analysis of up to 5 countermeasures for one project. After selecting the countermeasure, the CRF, crash type affected, service life and countermeasure units will automatically populate. Note that if only aggregate crash data are provided, the tool will only calculate a benefit for countermeasures that affect All Crash Types.

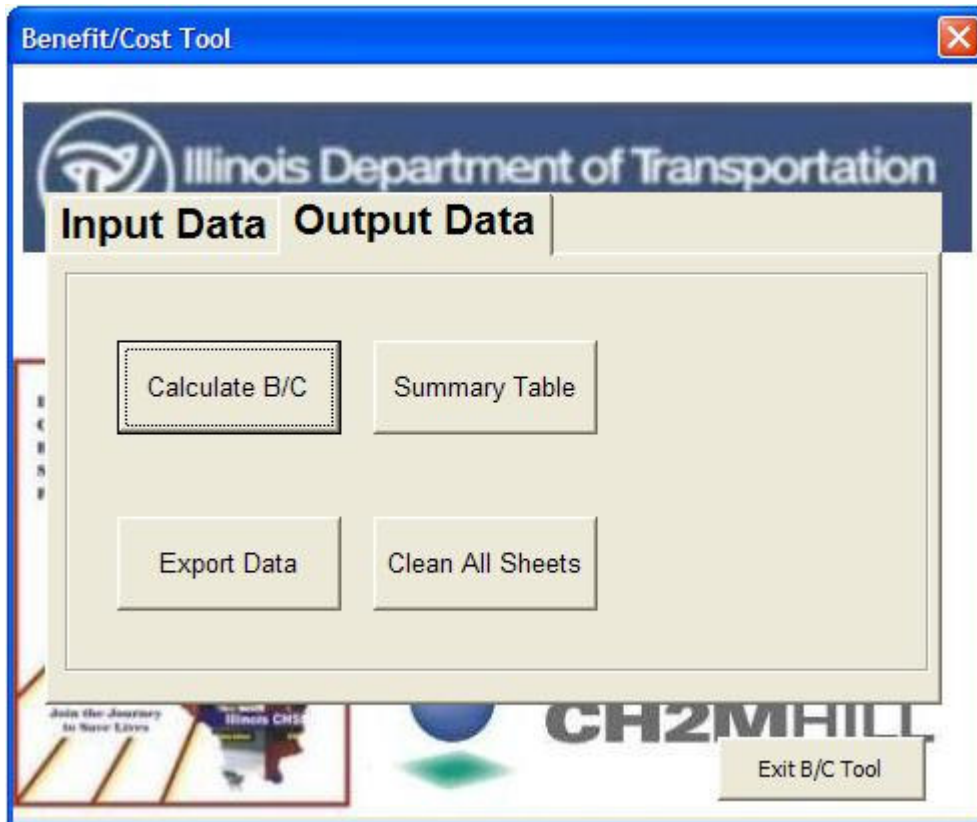
STEP 17: Enter the **Unit Cost** and **Quantity** for each countermeasure. For example, enter \$10,000 and 1 if you are adding signing of this cost at one intersection. When complete, select **Return to Main**. Be sure to "enter" the last data entered by using the Enter key or clicking another cell before attempting to click the Return to Main button.

STEP 18: Enter the user-defined countermeasure description in the first box under countermeasures, shown in yellow. This box currently contains the text “User defined 01”. Enter the unit of measurement, service life, CRF, and crash type affected to the right of the countermeasure description. Refer to the “Desktop Reference for Crash Reduction Factors” as discussed above to obtain CRF values. Crash Type Affected should be entered by using the abbreviations shown in the table below, separated by commas without spaces. Examples are shown in the window above the input data.

Legend	
<i>All</i>	All Crashes
<i>AG</i>	Angle
<i>AN</i>	Animal
<i>FO</i>	Fixed Object
<i>HO</i>	Head On
<i>LT</i>	Left Turn
<i>OtherNC</i>	Other Noncollision
<i>OtherO</i>	Other Object
<i>OVT</i>	Overtaken
<i>PD</i>	Pedestrian
<i>PDC</i>	Pedalcyclist
<i>PV</i>	Parked Vehicle
<i>RE</i>	Rear End
<i>RT</i>	Right Turn
<i>SSD</i>	Sideswipe Same Direction
<i>SCD</i>	Sideswipe Opposite Direction
<i>T</i>	Turning
<i>TR</i>	Train
<i>NGT</i>	Night Time crash
<i>WP</i>	Wet Pavement

STEP 19: After completing the user defined countermeasure information, select the “Place New CRFs” button. This will populate the CRFs to the appropriate crash types in the columns to the right of the input data. Additional user defined countermeasures can be added in the User defined02 and User defined 03 lines.

When complete select **Return to Main**.



When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown above will appear.

STEP 20: Click on the **Calculate B/C** button to obtain the benefit-cost ratio.



The image above will appear with the benefit /cost ratio for this project.

If you would like to test different countermeasure scenarios, you can go back to the **Input Data** tab, modify the input and re-run calculation of the B/C. This can be run as many times as desired to obtain the most favorable B/C ratio.

If you would like to erase and re-enter the crash data, select **Clean All Sheets**. The prompt will ask **Are you sure?** before deleting the information.

Select **Summary Table** to see a summary of the analysis or to verify inputs.

The above window will appear when “Summary Table” is selected.

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3.0 Special Cases - Partial Application of Countermeasures

One may wish to consider applying a safety-based countermeasure to part but not all of a segment or intersection. For example, left turn lanes may be contemplated for one roadway but not the crossing facility at an intersection. Should this be the case, the analyst must take care to properly estimate expected benefits and calculate an appropriate B/C ratio.

Proper use of the tool for such cases requires the analyst perform the benefit calculation taking into account the specific countermeasure application. This means calculating benefits separately for each approach or segment, applying only those countermeasures that apply to that approach, and applying them only to the crashes associated with that approach or segment. The following procedure is suggested:

STEP ONE: Determine which countermeasures apply to each intersection approach or segment

STEP TWO: Identify or designate which crashes are associated with each segment (best practices would be to refer to a crash diagram), inputting only those crashes into the worksheet that apply to that segment

STEP THREE: Perform the procedure as outline in this manual, calculating total benefits and costs for each unique segment and approach. Take care to label the input as 'approach A' or 'segment B', etc.

STEP FOUR: Sum all benefits and all costs from each approach calculation, and calculate a single overall project B/C.

This procedure can apply where multiple countermeasures are being studied. For example, one countermeasure may apply to the entire segment but the second to only part or parts of the study area. Use the tool to compute benefits for each unique segment, identifying the proper countermeasures for each one.

Care should be taken in designating crashes to not 'double count' or apply any one crash or crash type to multiple segments. Similarly, costs by segment should be carefully assigned to avoid double counting.

Note that the tool output will provide a B/C ratio for each approach. This *should not be used* (i.e., it is not correct to 'average' the segment B/C ratios); rather only the costs and benefits provided in the output should be used to compute *one overall B/C ratio*.

4.0 Reading a Crash Report for Benefit-Cost Input Tool

Key input factors for the countermeasure tool are crash type, crash severity, weather condition and time of day. This example indicates the area of a crash report where this information can be obtained.

Crash type – This is coded as an Event in the lower left hand corner of the report. The event coded Unit 1 and Event 1 is usually the cause of the crash. In this example the crash type is “1”. Using template 1, indicates a non-collision, run off the roadway event. The event in row 3 shows a “2”. Again using template 1, this indicates that after running off of the road the vehicle is overturned.

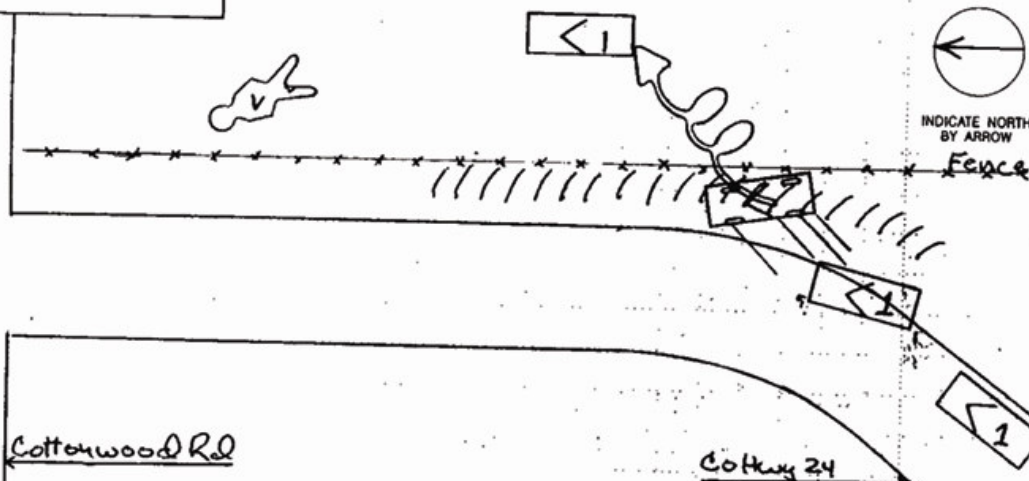
Crash severity – Injury type is coded in the middle of the crash report to the right of the description of Unit 1. In this example the injury was “K” or fatal. “A” is an incapacitating injury, “B” is a noncapacitating injury, “C” is reported, but not evident, and “0” is no indication of injury. If there are multiple vehicles involved in the crash use the most severe injury type to describe the crash severity.

Weather condition – To determine if the pavement was wet during this crash refer to the column on the right of the report. The sixth entry from the top is labeled “RSUR” and reflects the roadway surface condition. In this example a “1” refers to dry pavement.

Night time crashes – To determine if this crash occurred at night, refer to the top line sixth box from the left labeled “LGHT”. This refers to the lighting condition. For this example “4” indicates “darkness”. Therefore, night time crashes should be selected.

5102776

DIAGRAM



NARRATIVE (Refer to vehicle by Unit No.)

Unit #1 was NB on Cottonway 24, 2 mi S. of Cottonwood Rd at this point Unit #1 left the roadway to the East. Unit #1 was skidding broadside and struck the embankment. Upon impact Unit #1 became airborne continuing E. into a soybean field. Unit #1 rolled over approx. 3 times. Unit #1 Driver was ejected from Unit #1 and was found approx 100' from Unit #1 to the North.

COMMERCIAL VEHICLE

UNIT NO.

CARRIER NAME	SOURCE
ADDRESS	<input type="checkbox"/> Side of truck
CITY	<input type="checkbox"/> Papers
STATE	<input type="checkbox"/> Driver
ZIP	<input type="checkbox"/> Log book
ID NUMBER	GWWR
US DOT or State No.	ICCMC
HAZARDOUS MATERIALS:	HAZARDED? <input type="checkbox"/> Yes <input type="checkbox"/> No
If Yes: 4-Digits _____ 1-Digit _____	or Name _____
Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)	Y N Unk
Violation of HAZMAT regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Violation of MCS regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Inspection form completed?	Form No. _____
HAZMAT <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Unk	Out of Service? <input type="checkbox"/> Y <input type="checkbox"/> N
MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
IDOT PERMIT # _____	WIDE LOAD <input type="checkbox"/>
TRAILER WIDTH(S) _____	TRAILER LENGTH(S) - # _____
Trailer 1 <input type="checkbox"/> 0-96" 97-102" Over 102"	Trailer 1 _____
Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 2 _____
	NO. OF AXLES _____
<input type="checkbox"/> IN CITY OF / <input type="checkbox"/> NEAREST CITY: _____	Miles N E S W of: _____

INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO
VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____

COMMERCIAL VEHICLE

UNIT NO.

CARRIER NAME	SOURCE
ADDRESS	<input type="checkbox"/> Side of truck
CITY	<input type="checkbox"/> Papers
STATE	<input type="checkbox"/> Driver
ZIP	<input type="checkbox"/> Log book
ID NUMBER	GWWR
US DOT or State No.	ICCMC
HAZARDOUS MATERIALS:	HAZARDED? <input type="checkbox"/> Yes <input type="checkbox"/> No
If Yes: 4-Digits _____ 1-Digit _____	or Name _____
Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)	Y N Unk
Violation of HAZMAT regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Violation of MCS regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Inspection form completed?	Form No. _____
HAZMAT <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Unk	Out of Service? <input type="checkbox"/> Y <input type="checkbox"/> N
MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
IDOT PERMIT # _____	WIDE LOAD <input type="checkbox"/>
TRAILER WIDTH(S) _____	TRAILER LENGTH(S) - # _____
Trailer 1 <input type="checkbox"/> 0-96" 97-102" Over 102"	Trailer 1 _____
Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 2 _____
	NO. OF AXLES _____
<input type="checkbox"/> IN CITY OF / <input type="checkbox"/> NEAREST CITY: _____	Miles N E S W of: _____





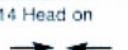


INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO
VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____

ILLINOIS TRAFFIC CRASH REPORT

TEMPLATE 1

Printed by authority of the State of Illinois

SR 1000A 2M (REPRINT 10/06)

EVENT (EVNT)		WEATHER CONDN. (WEAT)		TYPE OF FIRST CRASH (COLL)		PED/PEDAL LOCATION (PPL)		VEHICLE TYPE (VEHT)			
NONCOLLISION: 1 Ran off the roadway 2 Overtake 3 Fire/explosion 4 Immersion 5 Jackknife 6 Cargo shift/loss 7 Separation 8 Downhill runaway 9 Other noncollision 99 Unknown COLLISION WITH: NOT FIXED OBJECTS: 11 Motor vehicle in traffic 12 Pedestrian 13 Pedalcyclist 14 Railway train 15 Deer 16 Other animal 17 Falling load 18 Parked vehicle 19 Thrown/falling object 20 Other object 99 Unknown FIXED OBJECTS: 21 Crash cushion 22 Guardrail face 23 Guardrail end 24 Concrete med. barrier 25 Bridge support 26 Bridge end 27 Bridge rail 28 Bridge underside 29 Traffic signal 30 Light support 31 Utility pole 32 Delineator post 33 Railroad signal/gates 34 Other pole or post 35 Culvert 36 Curb 37 Ditch/embankment 38 Snowbank 39 Fence 40 Mailbox 41 Tree or shrub 42 Building/structure 43 Other fixed object 99 Unknown		TRAFFIC CONTROL DEVICE (TRFD) 1 No controls 2 Stop sign/flasher 3 Traffic signal 4 Yield 5 Police/flagman 6 RR crossing gate 7 Other RR crossing 8 School zone 9 No passing 10 Other reg. sign 11 Other warning sign 12 Lane use marking 13 Other 99 Unknown DEVICE CONDN. (TRFC) 1 No controls 2 Not functioning 3 Functioning improperly 4 Functioning properly 5 Worn reflect. material 6 Missing 7 Other 9 Unknown		SINGLE VEHICLE CRASH Select a code for a Single Vehicle Crash based on the crash code that illustrates what caused the first damage/injury, not what caused the most severe damage/injury. 1 Pedestrian 2 Pedalcyclist 3 Train 4 Animal 5 Overturned 6 Fixed object 7 Other object 8 Other noncollision Example: A motor vehicle skids on ice, loses control and strikes a guardrail. The COLL code should be 6 - Fixed object because no damage occurred until the guardrail was struck.		MULTI VEHICLE CRASH The intended direction of travel of each motor vehicle prior to the onset of the crash should determine the selection of the Multi Vehicle Crash code, not the direction of travel or position/angle of the vehicle at the point of contact. If the first damage/injury occurs when two vehicles strike, you must select a code 9-15. 9 Parked motor vehicle 10 Turning (at least one vehicle turning)  11 Rear end  12 Sideswipe same direction  13 Sideswipe opposite direction  14 Head on  15 Angle  Example: Unit 1 is NB and Unit 2 is SB on a four-lane divided roadway. Unit 1 skids on ice, loses control, crosses the grass median, re-enters the roadway into oncoming traffic, and collides with Unit 2. The COLL code should be 14 - Head on because no damage occurred until the two units collided.		PED/PEDAL ACTION (PPA) 3 Turning left 4 Turning right 20 Enter from drive/alley 50 No action 51 Crossing - with signal 52 Crossing - against signal ENTERING / LEAVING / CROSSING 53 School bus (within 50 ft.) 54 Parked vehicle 55 Not at intersection WALKING / RIDING 56 With traffic 57 Against traffic 58 To/from disabled vehicle OTHER: 59 Waiting for school bus 60 Playing/working on vehicle 61 Playing in roadway 62 Standing in roadway 63 Working in roadway 64 Other action 99 Unknown/NA		VEHICLE TYPE (VEHT) 1 Passenger 2 Pickup 3 Van/mini-van 4 Bus up to 15 pass. 5 Bus over 15 pass. 6 Truck - single unit 7 Tractor w/ semi-trailer 8 Tractor w/o semi-trailer 9 Farm equipment 10 Motorcycle (over 150cc) 11 Motor driven cycle 12 Snowmobile 13 All-terrain vehicle (ATV) 14 Other vehicle with trailer 15 Sport utility vehicle (SUV) 16 Other 99 Unknown/NA VEHICLE USE (VEHU) 1 Not in use 2 Personal 3 Driver education 4 Ambulance 5 Fire 6 Police 7 School bus 8 CTA 9 Mass transit 10 Other transit 11 Military 12 Agriculture 13 Tow truck 14 Construction/maintenance 15 House trailer 16 Camper/RV - towed/multi-unit 17 Camper/RV - single unit 18 Taxi/for hire 19 Commercial - multi-unit 20 Commercial - single unit 21 State owned 98 Other 99 Unknown/NA	
EVENT LOCATION (LOC) 1 On pavement (roadway) 2 Off pavement - left 3 Off pavement - right 4 Intersection 5 Other 9 Unknown		VEHICLE MANEUVER PRIOR (MANV) 1 Straight ahead 2 Passing/overtaking 3 Turning left 4 Turning right 5 Turning on red 6 U-turn 7 Starting in traffic 8 Slow/stop - left turn 9 Slow/stop - right turn 10 Slow/stop - load/unload 11 Slow/stop in traffic 12 Driving wrong way 13 Changing lanes 14 Avoiding vehicles/objects 15 Skidding/ control loss 16 Entering traffic lane from parking 17 Leaving traffic lane to park 18 Merging 19 Diverging 20 Enter from drive/alley 21 Parked 22 Parked in traffic lane 23 Backing 24 Driverless 25 Other 26 Negotiating a curve 99 Unknown/NA		CRASH DATA SAVES LIVES! NUMBER OF OCCUPANTS (NO. OCCS) DIRECTION TRAVEL PRIOR (DIRP) 							

ILLINOIS TRAFFIC CRASH REPORT

TEMPLATE 2

Printed by authority of the State of Illinois

SR 1000B 2M (REPRINT 10/06)

APPARENT PHYSICAL CONDITION (DRAC)
 1 Normal
 2 Impaired - alcohol
 3 Impaired - drugs
 4 Illness
 5 Asleep/fainted
 6 Medicated
 7 Had been drinking
 8 Fatigued
 9 Other/unknown

SEATING POSITION (SEAT)

1	2	3
4	5	6
10	11	12

 7 Enclosed passengers
 8 Exposed passengers

INJURY CLASSIF. (INJ)
 K Fatal
 A Incapacitating injury
 B Nonincapacitating injury
 C Reported, not evident
 O No indication of injury

PED / BIKE VISIBILITY (PEDV)
 1 No contrasting clothing
 2 Contrasting clothing
 3 Reflective material
 4 Other light source used

SAFETY EQUIPMENT USED (SAFT)
 1 None present
 2 Safety belt used
 3 Safety belt not used
 4 Helmet used
 5 Helmet not used
 6 Child restraint used
 7 Child restraint used improperly
 8 Child restraint not used
 9 Usage Unknown

AIR BAG DEPLOYED (AIR)
 3 Not applicable
 4 Did not deploy
 5 Deployed, front
 6 Deployed, side
 7 Deployed other (knee, air belt, etc.)
 8 Deployed, combination
 9 Deployment unknown

DRIVER VISION (VIS)
 1 Not obscured
 2 Windshield (water/ice)
 3 Trees, plants
 4 Buildings
 5 Embankment
 6 Signboard
 7 Hillcrest
 8 Parked vehicles
 9 Moving vehicles
 10 Blinded - headlights
 11 Blinded - sunlight
 12 Blowing materials
 13 Other
 99 Unknown

DRIVER ACTION (DRVA)
 1 None
 2 Failed to yield
 3 Disregarded control devices
 4 Too fast for conditions
 5 Improper turn
 6 Wrong way/side
 7 Followed too closely
 8 Improper lane change
 9 Improper backing
 10 Improper passing
 11 Improper parking
 12 License restrictions
 13 Stopped school bus
 14 Emergency vehicle on call
 15 Evading police vehicle
 16 Other
 99 Unknown

VEHICLE DEFECTS (VEHD)
 1 None
 2 Brakes
 3 Steering
 4 Engine/motor
 5 Suspension
 6 Tires
 7 Exhaust
 8 Lights
 9 Signals
 10 Windows
 11 Restraint system
 12 Wheels
 13 Trailer coupling
 14 Cargo
 15 Fuel system
 16 Other
 99 Unknown

PRIVATE PROPERTY: This is not the area to indicate that there was private property damage. Check **Yes only if the crash began on, ended on and all damage occurred on private property.**

 If the crash began on a public roadway, it is not a private property crash; check **No.**

EJECTION OR EXTRICATION (EJCT)
 1 None
 2 Totally ejected
 3 Partially ejected
 4 Trapped/extricated
 9 Unknown

TRAFFICWAY DESCRIPTION (TRFW)

TWO-WAY	OTHER
1 Not divided	5 One-way or ramp
2 Divided, no median barrier	6 Alley or driveway
3 Divided w/median barrier	7 Parking lot
4 Center turn lane	8 Other
	9 Unknown

NUMBER OF LANES (NO. LANES)
 Count through lanes, both directions. If at intersection, use "0" (zero).

ALIGNMENT (ALGN)
 1 Straight and level
 2 Straight on grade
 3 Straight on hillcrest
 4 Curve, level
 5 Curve on grade
 6 Curve on hillcrest

ROADWAY SURFACE CONDITION (RSUR)
 1 Dry
 2 Wet
 3 Snow or slush
 4 Ice
 5 Sand, mud, dirt
 6 Other
 9 Unknown

ROAD DEFECTS (RDEF)
 1 No defects
 2 Construction zone
 3 Maintenance zone
 4 Utility work zone
 5 Work zone - unk.
 6 Shoulders
 7 Rut, holes
 8 Worn surface
 9 Debris on roadway
 10 Other
 99 Unknown

DRIVER BAC TEST RESULT (BAC)
 Enter BAC result or one of the following:
 95 Test refused
 96 Test not offered
 97 Test performed results unknown

DRUG TEST
 If drug test was given put in the narrative

UNIT NO.
DATE OF BIRTH
mo/day/yr

PASSENGERS & WITNESSES
Full Name, Address, Telephone

TAKEN TO (hospital)

EMS RUN NUMBER or AGENCY NAME

5.0 Examples

5.1 Case Study 1: Benefit Cost Analysis for a Segment.

The roadway segment along IL 0 between Maple Street and Oak Street was identified as a hazardous location. It is located in District 10, Wooded County, in the Village of Forest. From 2001 to 2005 there were 3 fatal crashes, 6 A-injury crashes, and 10 B-injury crashes. There were also C- injury and property damage only crashes at this location, but the exact number is not needed for the analysis. There are 3 night time crashes, 1 A-injury and 2 B-injury. A majority of the crashes were fixed object and overturn. The current AADT is 9500.

Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding rumble strips to the existing shoulder.

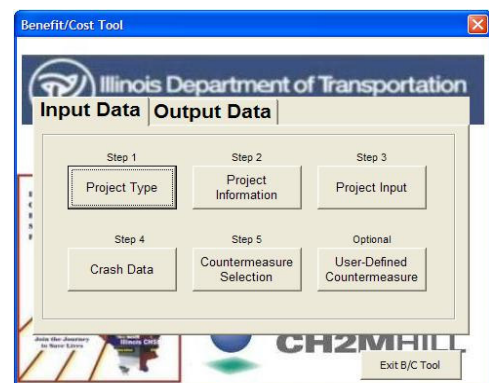
Step-by-Step Procedures

STEP 1: Start by pressing the **Start B/C Tool** button.



STEP 2: Select the **Input Data** tab.

STEP 3: Select the button labeled **Project Type**



Project type selection

Project Type

☐ Intersection ☒ Segment

Traffic Control

☐ Signalized ☐ Unsignalized

Segment Type

☐ Urban ☒ Rural

Return to Main

STEP 4: Select project type by clicking on the circle next to **Segment**. Select **Rural** under Segment Type.

When complete click on the **Return to Main** button to return to the main input window.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional User-Defined Countermeasure

Exit B/C Tool

STEP 5: On the main menu, select the button labeled **Project Information**.

Project Information

Project : ILO Segment Improvement

District: 10 County: Wooded City: Forest

Key Route: 063 81000 000000 Marked Route: ILO MilePost:

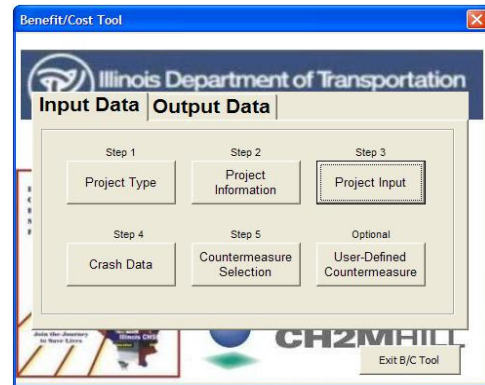
Location : Roadway segment ILO between Maple Street and Oak Street

Prepared by : DPB Date (mm/dd/yyyy) : 11/10/2007

Return to Main

STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

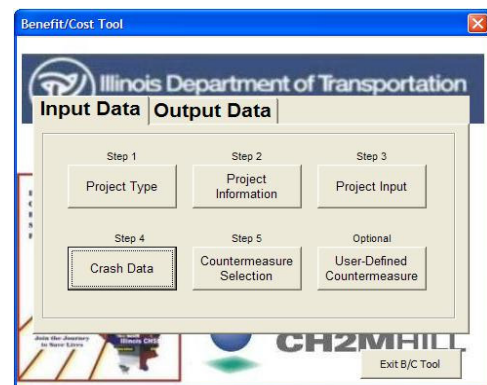
STEP 7: Select the button labeled **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When complete with all fields click on **Return to Main**.

The screenshot shows the 'Segment Input' window. It contains several input fields: 'Crash Data' with a range from '2001' to '2005'; 'Current AADT' with the value '9500'; 'Length (Miles)' with the value '2.3'; 'Traffic Growth' with a value of '1.25' and a note 'Specify a value between 1 to 5%'; and 'Discount rate' with the value '4.00'. At the bottom, there is a 'Return to Main' button.

STEP 9: Select the button labeled **Crash Data**.



Crash Data

Crash Data Availability

What type of crash data do you have available? :

☒ Crash Severity Distribution by Crash type

☐ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : ☐ Yes

Do you have wet pavement crashes? : ☐ Yes

Enter Crash Data

STEP 10: Select **Crash Severity Distribution by Crash Type** by clicking on the circle next to the text. When complete, select the **Enter Crash Data** button.

STEP 11: Enter the crash data for the analysis period by crash type and severity as shown. When complete, select the **Return to Main** button

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																	
2		Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtaken	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train
3		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR
4	Fatal Crashes	1		1												1		
5	A-Injury Crashes			2	1				3									
6	B-Injury Crashes			5	1		1		1						1	1		
7	C-Injury Crashes								1									
8	PDO Crashes																	
9																		
10																		
11																		
12																		
13																		
14																		
15																		

Return to Main

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP 12: Select the button labeled **Countermeasure Selection**.

STEP 13: Select 2.1.4 Rumble Strips (Shoulder) from the countermeasure dropdown menu.

SEGMENTS BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CRF *	Crash Type affected by this improvement			Unit Cost	Quantity	Units	Total Cost	Service Life
2.1.4 Rumble Strips (Shoulder)	30%	FO/OVT			\$9,000	2.3	Miles	\$20,700	3
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0

* CRF = Crash Reduction Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasure. When complete, select **Return to Main**.

When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

STEP 15: Click on the **Calculate B/C** button to obtain the benefit-cost ratio.

The image to the right will appear with the benefit /cost ratio for this project. Click the **OK** button to return to the main menu.

5.2 Case Study 2: Benefit Cost Analysis for a Signalized Intersection.

The signalized intersection of Maple Street and Oak Street was identified as a hazardous location. It is located in District 0, Wooded County, in the Village of Forest. From 2001 to 2005 there was 2 fatal crash, 38 A-injury crashes, and 63 B-injury crashes. There were also C-injury and property damage only crashes at this location. A majority of the crashes were angle and turning with turning representing the most severe crash type.

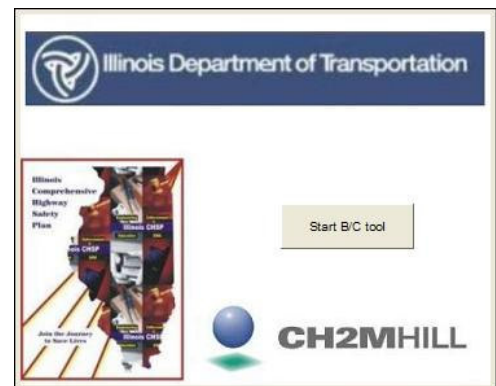
A road safety assessment was conducted and it was determined that there was a high left turn volume from a shared thru lane. The traffic signal heads were also difficult to see from a distance.

Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two countermeasures; an increase in the signal lens size to 12 inches for the entire intersection and a left turn lane with a left turn phase for two legs of the intersection. For this example the benefit-cost is calculated twice because intersection legs are being treated differently. After tool calculations are made, an external calculation must be made to obtain a final composite benefit-cost ratio.

In this example, the first b/c calculation will be for treatment of two legs of the intersection with the increase in signal lens size. The second calculation will be for treatment of the other two legs of the intersection with an increase in signal lens size and the addition of left turn lanes.

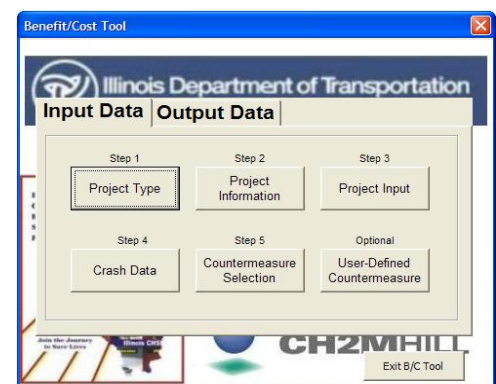
Step-by-Step Procedures

STEP 1: Start by pressing the **Start B/C Tool** button.



STEP 2: Select the **Input Data** tab.

STEP 3: Select the button labeled **Project Type**



Project type selection

Project Type

☒ Intersection ☐ Segment

Traffic Control

☒ Signalized ☐ Unsignalized

Segment Type

☐ Urban ☐ Rural

Return to Main

STEP 4: Select project type by clicking on the circle next to **Intersection** then select **Signalized**.

When complete click on the **Return to Main** button to return to the main input window.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data Output Data

Step 1 Step 2 Step 3

Project Type Project Information Project Input

Step 4 Step 5 Optional

Crash Data Countermeasure Selection User-Defined Countermeasure

Exit B/C Tool

STEP 5: On the main menu, select the button labeled **Project Information**.

Project Information

Project : Intersection Improvement - Maple Street & Oak Street

District: 0 County: Wooded City: Forest

Key Route: Marked Route: S176 MilePost: 0.8

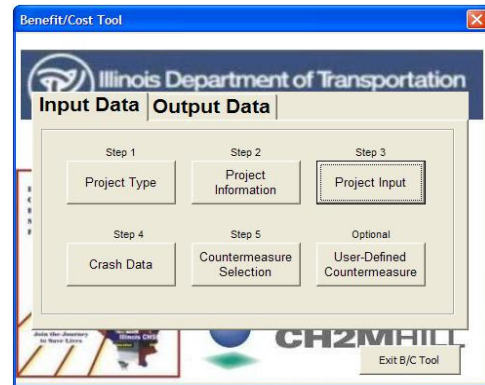
Location : Intersection of Maple St & Oak St

Prepared by : DPB Date (mm/dd/yyyy) : 11/09/07

Return to Main

STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

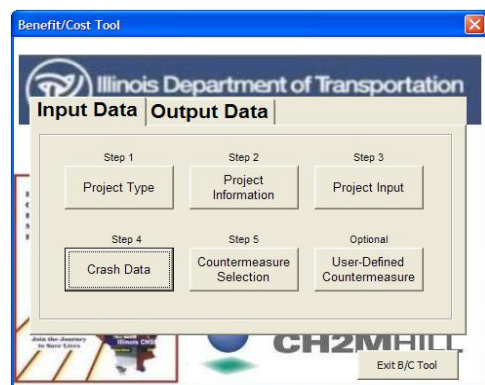
STEP 7: Select the button labeled **Project Input**.



STEP 8: Input the information requested in the fields of the **Intersection Input** window. When complete with all fields click on **Return to Main**.

The screenshot shows the 'Intersection Input' window. It contains several input fields: 'Crash Data' with 'From' and 'to' dropdowns set to '2001' and '2005' respectively; 'Current AADT' with 'Major approach' and 'Minor approach' text boxes containing '32000' and '28600'; 'Traffic Growth' with a text box containing '1.25' and a spinner; and 'Discount rate' with a text box containing '4.00' and a spinner. A note says 'Specify a value between 1 to 5%'. At the bottom is a 'Return to Main' button.

STEP 9: Select the button labeled **Crash Data**.



Crash Data

Crash Data Availability

What type of crash data do you have available? :

☒ Crash Severity Distribution by Crash type

☐ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : ☐ Yes

Do you have wet pavement crashes? : ☐ Yes

Enter Crash Data

STEP 10: Select **Crash Severity Distribution by Crash Type** by clicking on the circle next to the text. When complete, select the **Enter Crash Data** button

STEP 11: Enter the crash data for the analysis period by crash type and severity as shown. Crash data entered should only be for the two legs of the intersection that are going to be treated with increasing the lens size. When complete, select the **Return to Main** button

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																	
2		Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train
3		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PXV	RE	RT	SSD	SOD	T	TR
4																		
5	Fatal Crashes					1												
6	A-Injury Crashes	3				5							2				4	
7	B-Injury Crashes	6				10							3	1	1		7	
8	C-Injury Crashes																	
9	PDO Crashes																	
10																		
11																		
12																		
13																		
14																		
15																		

Return to Main

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | **Output Data**

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP 12: Select the button labeled **Countermeasure Selection**

STEP 13: Select 1.4.10 Increase to 12 Inch Lens from the countermeasure dropdown menu.

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CRF *	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life		
1.4.10 Increase to 12 inch Lens	25%	All	\$10,000	2	Unit Qty	\$20,000	10		
	0%	0			0	\$0	0		
	0%	0			0	\$0	0		
	0%	0			0	\$0	0		
	0%	0			0	\$0	0		
	0%	0			0	\$0	0		

***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).

* CRF = Crash Reduction Factor
 ** EUAC = Estimated Uniform Annual Cost

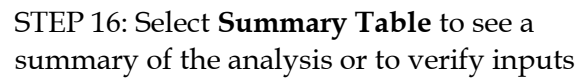
Return to Main

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasure. The cost entered should be the cost for increasing the lens size on two legs of the intersection. When complete, select **Return to Main**.

When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

STEP 15: Click on the **Calculate B/C** button to obtain the benefit-cost ratio.

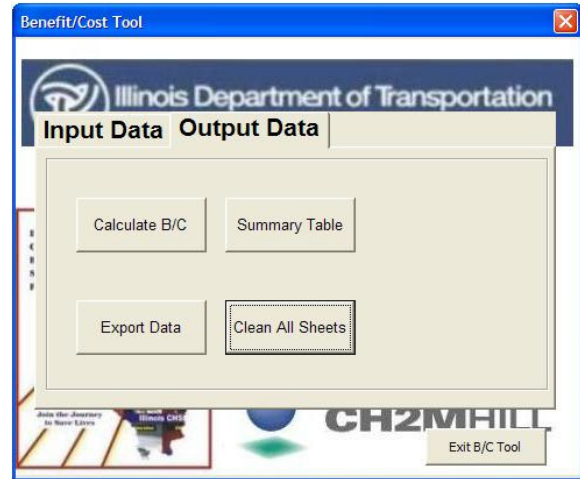
The image to the right will appear with the benefit /cost ratio for this project. Click the **OK** button to return to the main menu



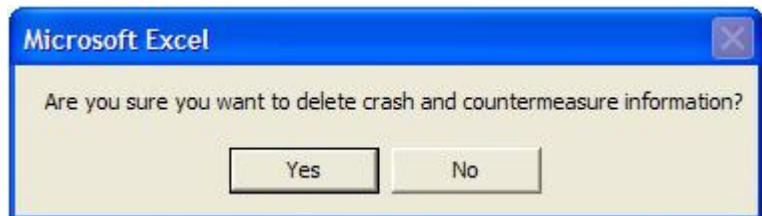
The above window will appear when “Summary Table” is selected.

The analysis for treating two legs of the intersection with increasing the lens size is complete. To treat the other two legs of the intersection with an increase in lens size and the addition of left turn lanes and left turn phases, continue with the following steps.

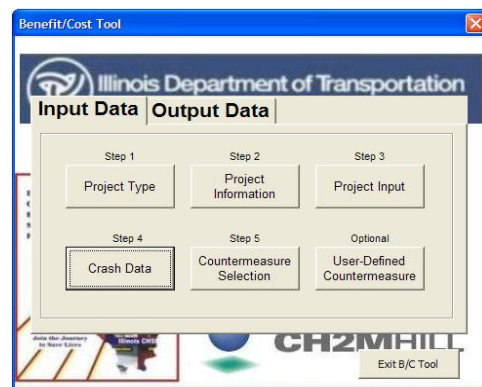
Step 17: The Project data has been already input into the menus, and the sheets. Click on the **Clean all Sheets** button to delete the input crash data to revise.



Step 18: Click **Yes** to confirm.



STEP 19: Select the button labeled **Crash Data**.



Crash Data

Crash Data Availability

What type of crash data do you have available? :

☒ Crash Severity Distribution by Crash type

☐ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : ☐ Yes

Do you have wet pavement crashes? : ☐ Yes

Enter Crash Data

STEP 20: Select **Crash Severity Distribution by Crash Type** by clicking on the circle next to the text. When complete, select the **Enter Crash Data** button

STEP 21: Enter the crash data for the analysis period by crash type and severity for the crashes on the legs of the intersection that will be treated with increasing the lens size and the addition of the left turn lanes. Crashes should appear under one of the two B/C analyses, not both so that there is not double counting of crashes. When complete, select the **Return to Main** button.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																	
2																		
3		Angle	Animal	Filed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtured	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sidewipe Same Direction	Sidewipe Opposite Direction	Turning	Train
4		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOO	T	TR
5	Fatal Crashes					1							4				8	
6	A-Injurg Crashes	4				8												
7	B-Injurg Crashes	7				15							1		2		10	
8	C-Injurg Crashes																	
9	PDO Crashes																	
10																		
11																		
12																		
13																		
14																		
15																		

Return to Main

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | **Output Data**

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP 22: Select the button labeled **Countermeasure Selection**.

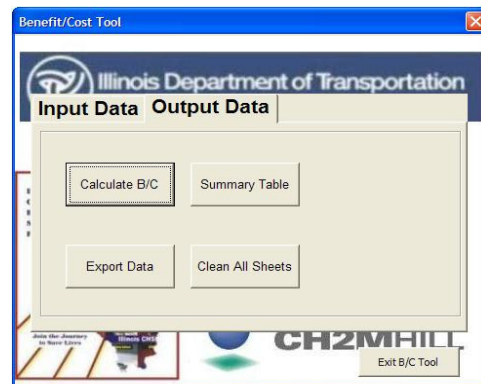
STEP 23: Select 1.4.7 Add Left Turn Phase with Left turn Lane, and 1.4.10 Increase to 12 Inch Lens from the countermeasure dropdown menu.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	INTERSECTION BENEFIT COST ANALYSIS														
2	BENEFIT CALCULATIONS							COUNTERMEASURE COST CALCULATIONS							
3															
4															
5															
6	COUNTERMEASURE							CRF *	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life	
7	1.4.7 Add Left Turn Phase with Left Turn Lane							55%	All	\$95,000	2	Unit Qty	\$170,000	10	
8															
9	1.4.10 Increase to 12 Inch Lens							25%	All	\$10,000	2	Unit Qty	\$20,000	10	
10															
11								0%	0			0	\$0	0	
12															
13								0%	0			0	\$0	0	
14															
15								0%	0			0	\$0	0	
16															
17	***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).														
18															
19	* CRF = Crash Reduction Factor														
20	** EUAC = Estimated Uniform Annual Cost														
21															
22															
23															

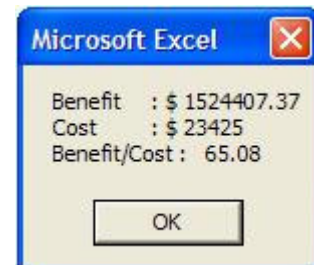
STEP 24: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**.

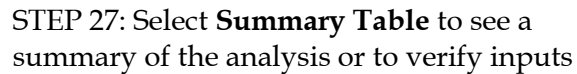
STEP 25: When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

STEP 26: Click on the **Calculate B/C** button to obtain the benefit-cost ratio.



The image to the right will appear with the benefit /cost ratio for this project. Click the **OK** button to return to the main menu.





The above window will appear when “Summary Table” is selected.

If you would like to save the run, select **Export Data**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

After completing the two benefit-cost analyses a, a combined b/c ratio can be obtained by adding the benefits and divided by the total cost. The total cost for this example is, \$25,891 and the total benefit is \$2,084,977.96. The composite B/C is 80.53.

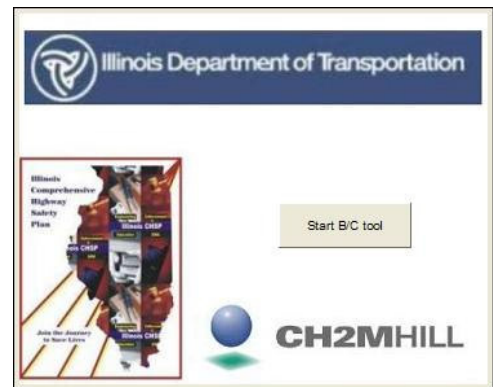
5.3 Case Study 3: Benefit Cost Analysis for a Systematic Improvement.

This case of study shows an analysis for systematic improvements at a series of locations that present similar type of risk or recurring number of crashes of certain type. The sites are located in District 10, and there are within 14 different counties' boundaries. A major crash pattern and risks at the different sites is associated with improvement and lack of warning signals.

This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two types of warning signs and chevrons to the existing sites.

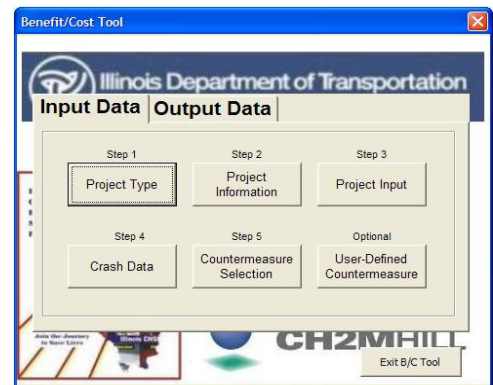
Step-by-Step Procedures

STEP 1: Start by pressing the **Start B/C Tool** button.



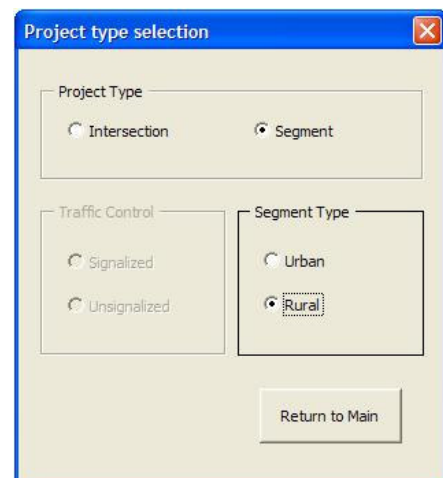
STEP 2: Select the **Input Data** tab.

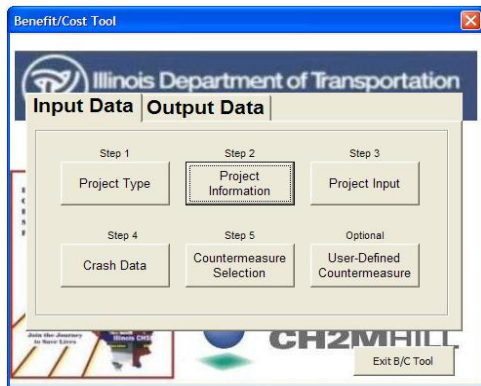
STEP 3: Select the button labeled **Project Type**



STEP 4: Select project type by clicking on the circle next to **Segment**. Select **Rural** under Segment Type.

When complete click on the **Return to Main** button to return to the main input window.





STEP 5: On the main menu, select the button labeled **Project Information**.

Project :

District: County: City:

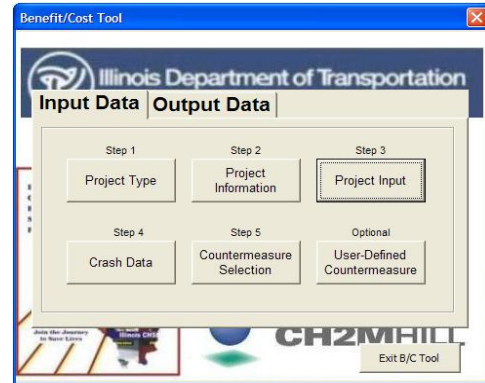
Key Route: Marked Route: MilePost:

Location :

Prepared by : Date (mm/dd/yyyy) :

STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

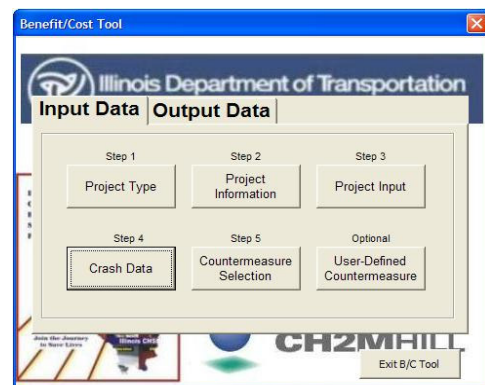
STEP 7: Select the button labeled **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When complete with all fields click on **Return to Main**.

The screenshot shows the 'Segment Input' window. It contains several input fields: 'Crash Data' with a range from '2000' to '2005'; 'Current AADT' with the value '3500-12000'; 'Length (Miles)' with an empty field; 'Traffic Growth' with a value of '1.25' and a note 'Specify a value between 1 to 5%'; and 'Discount rate' with a value of '4.00'. Each of these fields has a small up/down arrow icon. At the bottom center is a button labeled 'Return to Main'.

STEP 9: Select the button labeled **Crash Data**.



Crash Data

Crash Data Availability

What type of crash data do you have available? :

☒ Crash Severity Distribution by Crash type

☐ Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes? : ☐ Yes

Do you have wet pavement crashes? : ☐ Yes

Enter Crash Data

STEP 10: Select **Crash Severity Distribution by Crash Type** by clicking on the circle next to the text. When complete, select the **Enter Crash Data** button.

STEP 11: Enter the crash data for the analysis period by crash type and severity as shown. When complete, select the **Return to Main** button

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																	
2		Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train
3																		
4		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR
5	Fatal Crashes	1		1	2				2				1				1	
6	A-Injury Crashes	15		7	1			1	12		1		8				9	
7	B-Injury Crashes	9	1	15	6		4	3	12	1			20			4	13	
8	C-Injury Crashes																	
9	PDO Crashes																	
10																		
11																		
12																		
13																		
14																		
15																		

Return to Main

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP 12: Select the button labeled **Countermeasure Selection**.

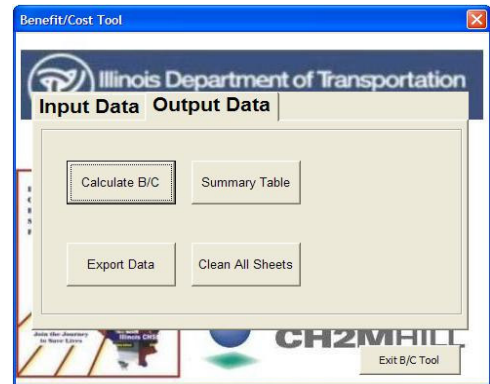
STEP 13: Select 2.3.8 Warning Signs – Standard, 2.3.9 Warning Signs – Special, and 2.5.8 Chevrons or Delineators from the countermeasure dropdown menu.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	SEGMENTS BENEFIT COST ANALYSIS															
2	BENEFIT CALCULATIONS								COUNTERMEASURE COST CALCULATIONS							
3																
4																
5																
6	COUNTERMEASURE								Crash Type affected by this improvement							
7	2.3.8 Warning Signs - Standard				40%		TR,FQ,RE,OVT		Unit Cost	Quantity	Units	Total Cost	Service Life			
8									\$58,000	1	Unit Qty	\$58,000	2			
9	2.3.9 Warning Signs - Special				40%		TR,FQ,RE,OVT		\$58,000	1	Unit Qty	\$58,000	5			
10																
11	2.5.8 Chevrons or Delineators				40%		OVT,HQ,SQD,FO		\$58,000	1	Unit Qty	\$58,000	4			
12																
13					0%		0				0	\$0	0			
14					0%		0				0	\$0	0			
15																
16																
17																
18																
19	* CRF = Crash Reduction Factor															
20	** EUAC = Estimated Uniform Annual Cost															
21																
22																
23																

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasure. When complete, select **Return to Main**.

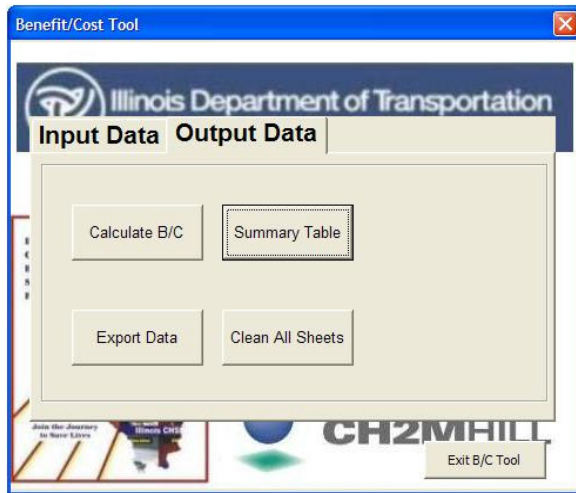
When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

STEP 15: Click on the **Calculate B/C** button to obtain the benefit-cost ratio.



The image to the right will appear with the benefit / cost ratio for this project. Click the **OK** button to return to the main menu.





STEP 16: Select **Summary Table** to see a summary of the analysis or to verify inputs.

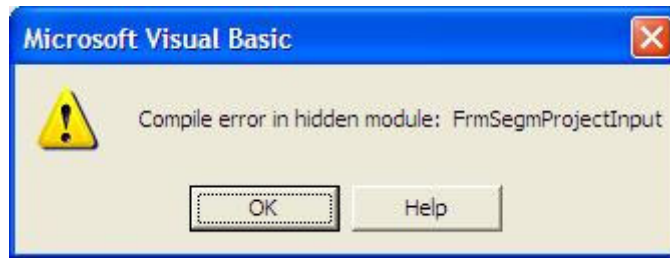
PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)																				
Project	Signing - Systematic Improvement										Prepared by	DPB								
District	10										Date	10/2/2007								
County	Alton										Current SAGT	3500-12000								
City	Alton										Length	Miles								
Location Class	Multiple locations, 14 Counties included										Right of Way Growth Factor	1.3%								
Crash data	6 Years										Interest Rate	4.0%								
From	2000																			
To	2005																			
Highway Class	RURAL HIGHWAY																			
SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																				
Crash Type	All Crashes	Angle	Animal	Fixed Object	Head On	Left Turn	Other Intersection	Other Object	Overrun	Pedestrian	Pedalcyclist	Parked Vehicle	Road End	Right Turn	Side-swing Same Direction	Side-swing Opposite Direction	Turning	Train	Night Time	Wet Pavement
Crash Severity	ALL	AG	AN	FO	HO	LT	Other Int	Other Obj	OVT	PO	POC	PV	RE	RT	SSD	SSO	T	TR	NAT	WP
Fatal Crashes	1			1	2			1	3				1			1				
A-Injury Crashes	5			1	1			1	1				1			4				
B-Injury Crashes	9	1		5	6			3	2				2			20				
C-Injury Crashes																				
PDO Crashes																				
SEGMENTS BENEFIT COST ANALYSIS																				
BENEFIT CALCULATIONS										COUNTERMEASURE COST CALCULATIONS										
COUNTERMEASURE	CRF *	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life	Present worth	EUAC **											
2.3.1 Warning Sign - Standard	40%	TRFO,RE,OVT	\$50,000	1	Unit Qty	\$50,000	2	\$110,24	\$25,074											
2.3.1 Warning Sign - Special	40%	TRFO,RE,OVT	\$50,000	1	Unit Qty	\$50,000	5	\$55,000	\$13,028											
2.5.0 Obstruction or Surface other	40%	OVT,HO,SCD,FO	\$50,000	1	Unit Qty	\$50,000	4	\$55,000	\$13,028											
TOTAL BENEFIT	*****																			
BENEFIT / COST										TOTAL COST										
195.90										\$8,106										
* CRF = Crash Reduction Factor																				
** EUAC = Estimated Uniform Annual Cost																				
Return to Main																				

The above window will appear when “Summary Table” is selected.

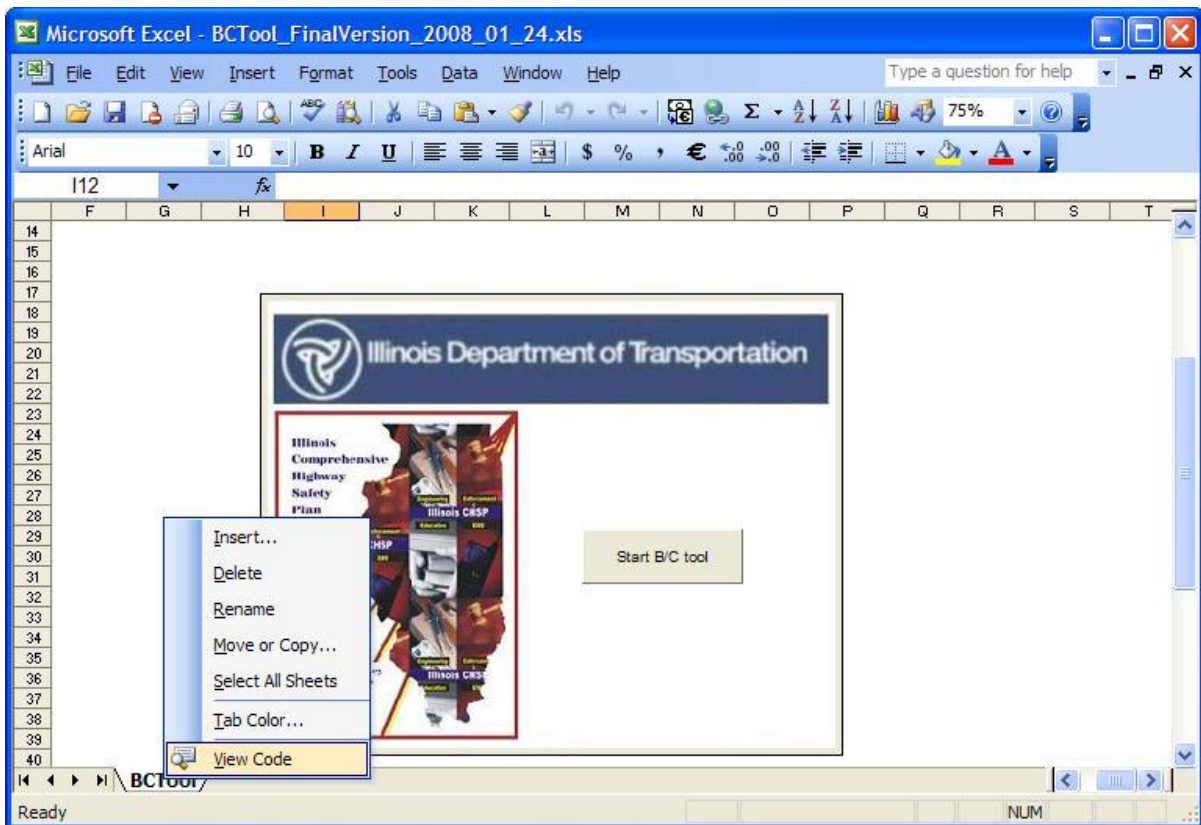
If you would like to save the run, select **Export Data**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

Troubleshooting Office 2003

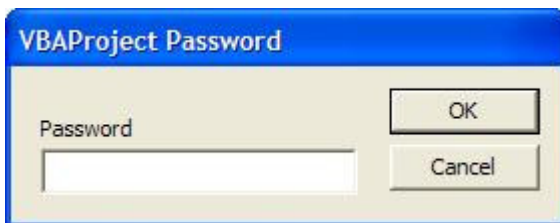
I am getting the error message shown below. How can I fix it?



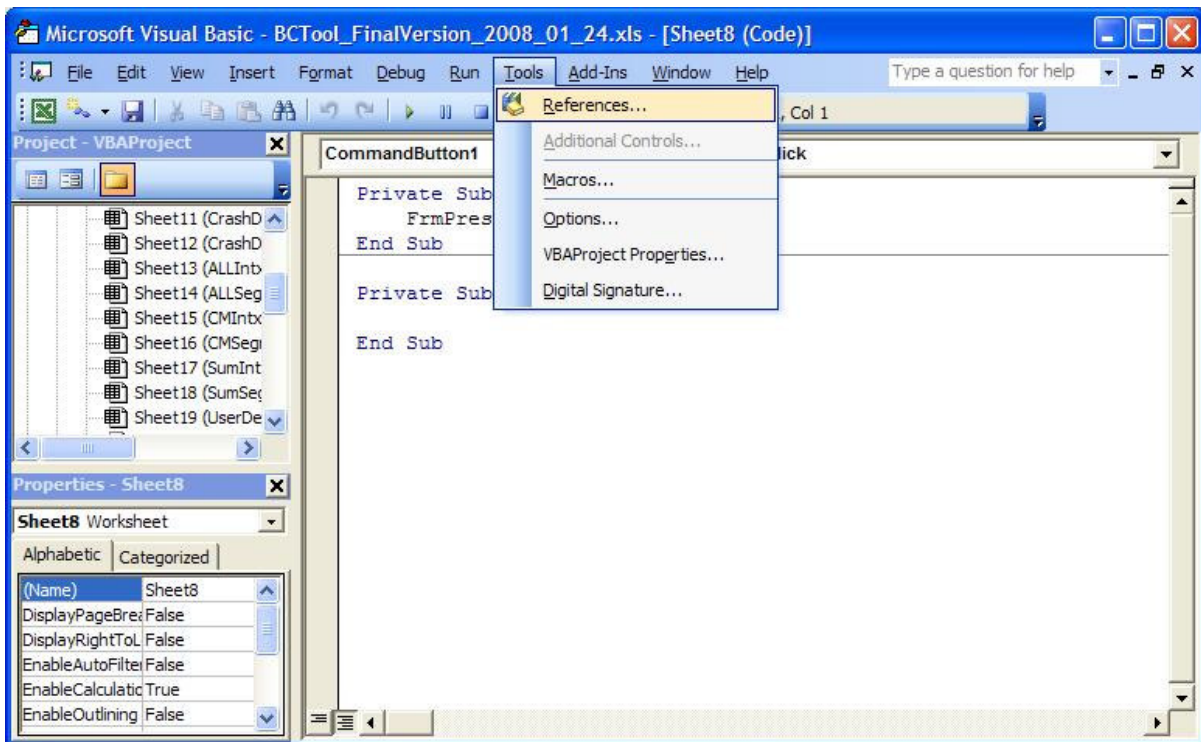
The first step to fix this error is to open the Visual Basic code. Right click on the BCTOOL tab located on the bottom left of the window. Select View Code from the pop up menu



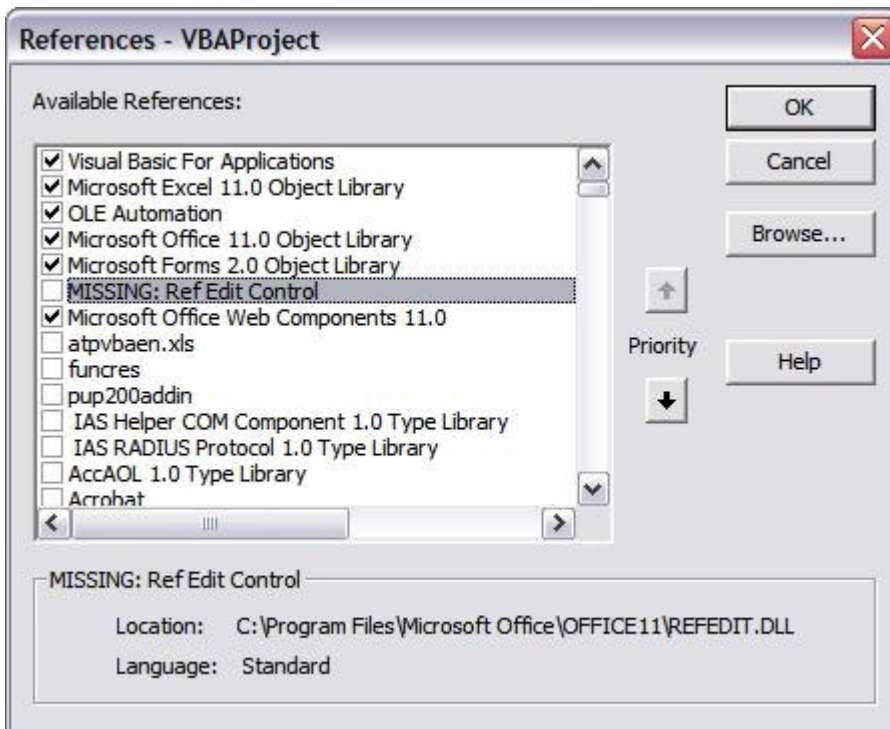
Since the tool is password protected, it is required to input the password (IDOTsafety) in the box shown below. Hit OK to continue.



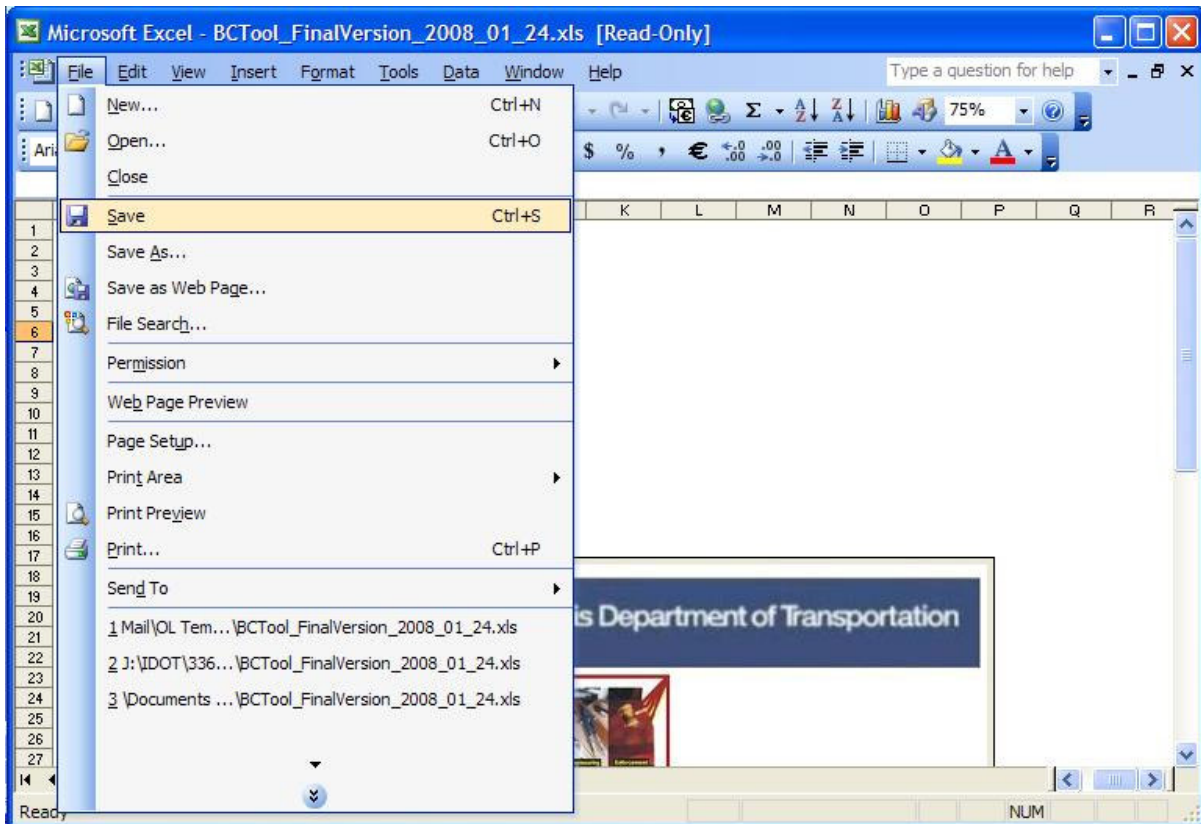
Select Tools – References from the top Microsoft Visual Basic toolbar



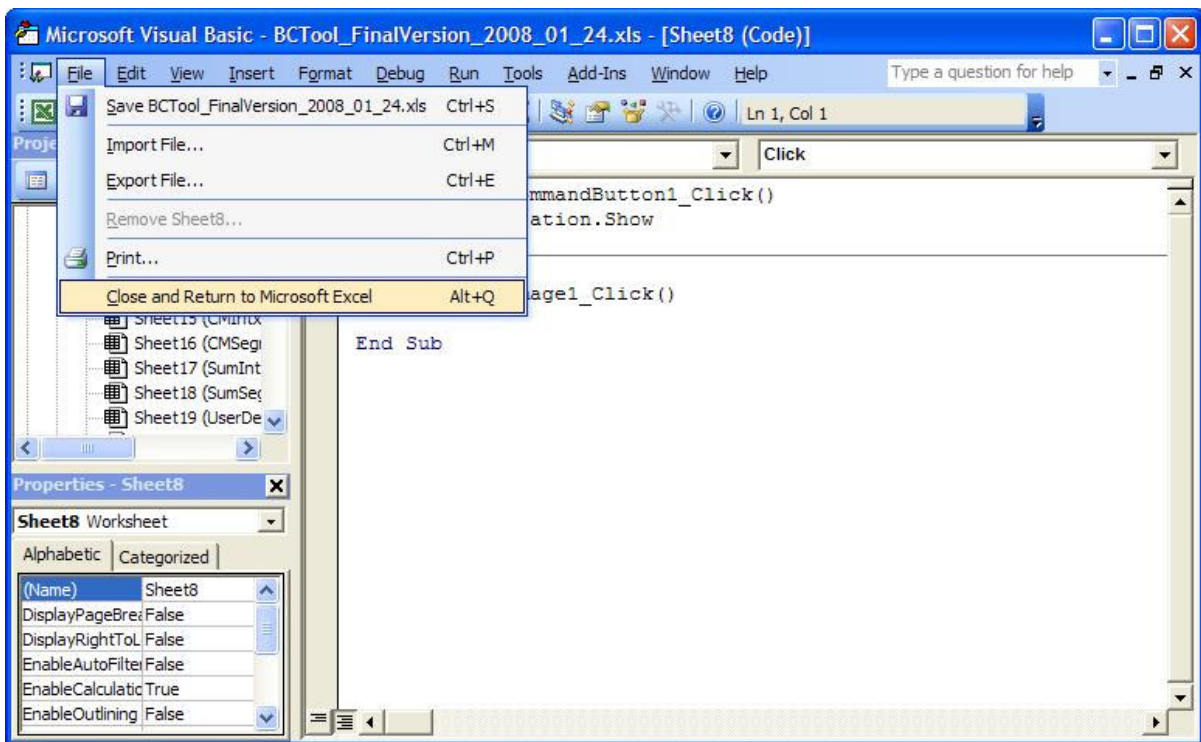
Look for the reference "Missing Ref Edit Control" and unchecked the box. Hit OK to continue.



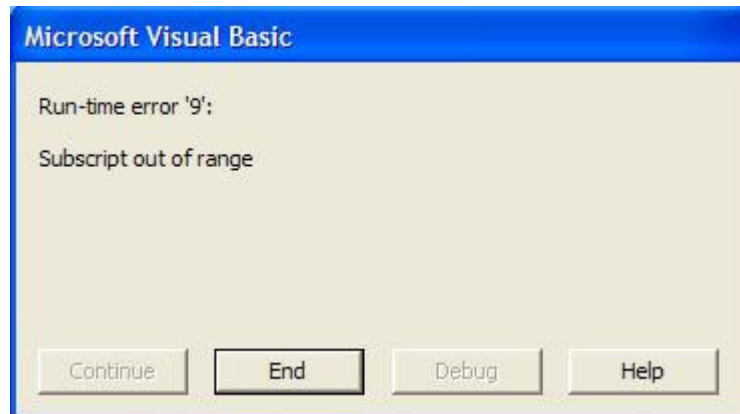
Go back to the Microsoft Excel window, and select File-Save from the top toolbar



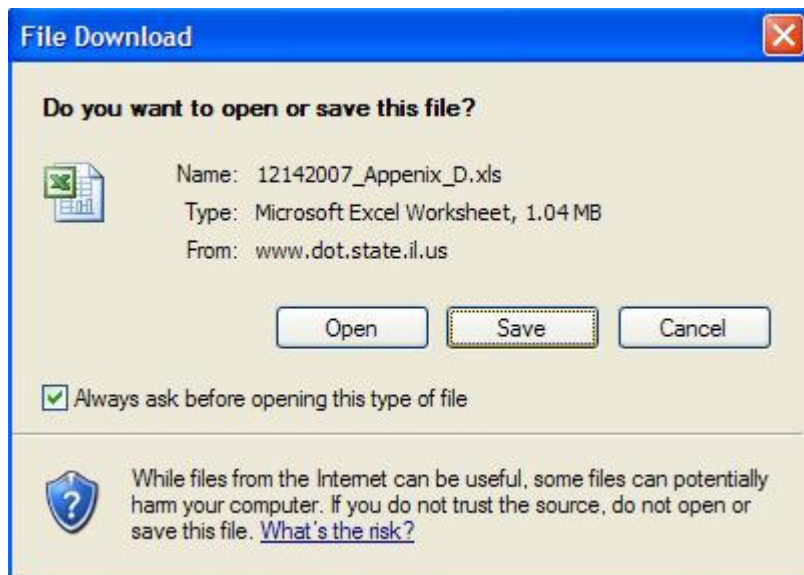
Once the file is saved, go back to the Visual Basic window, and select File - Close and Return to Microsoft Excel. Now you can start using the Benefit Cost Tool.



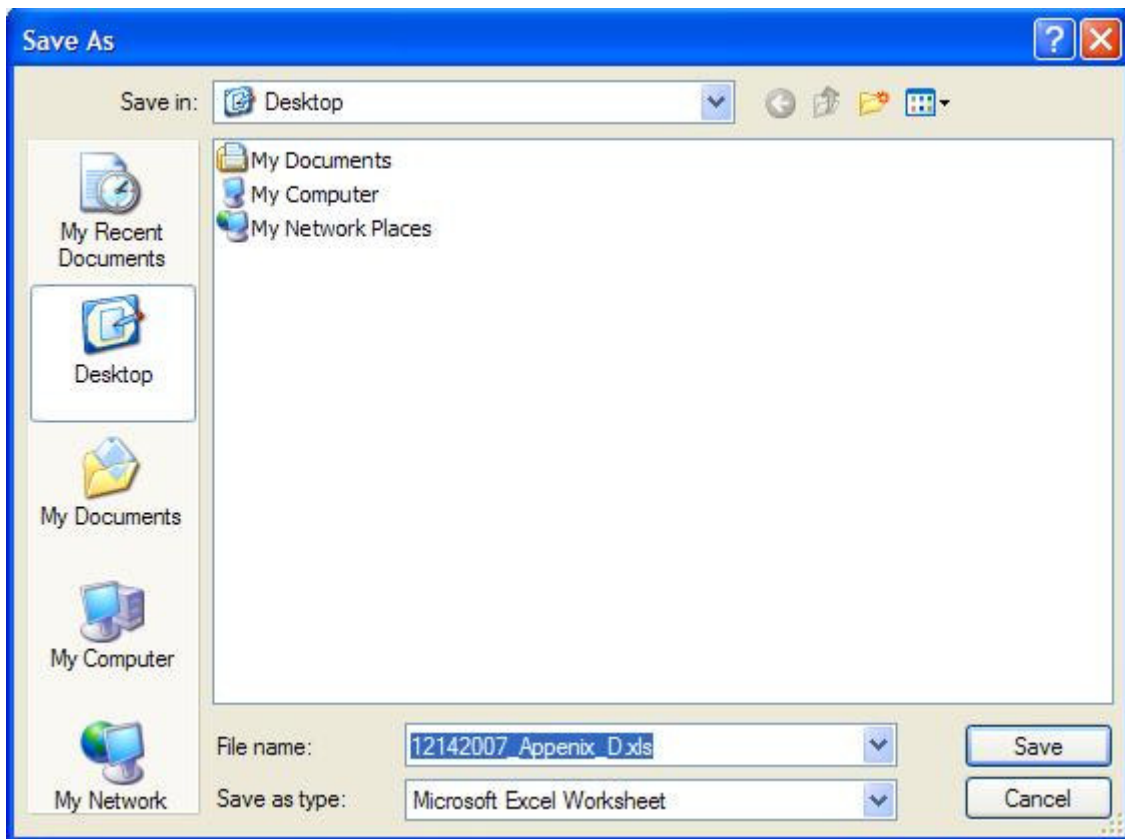
I open the file from IDOT website, and tried to run the tool, but I am getting the error shown below. How can I fix it?



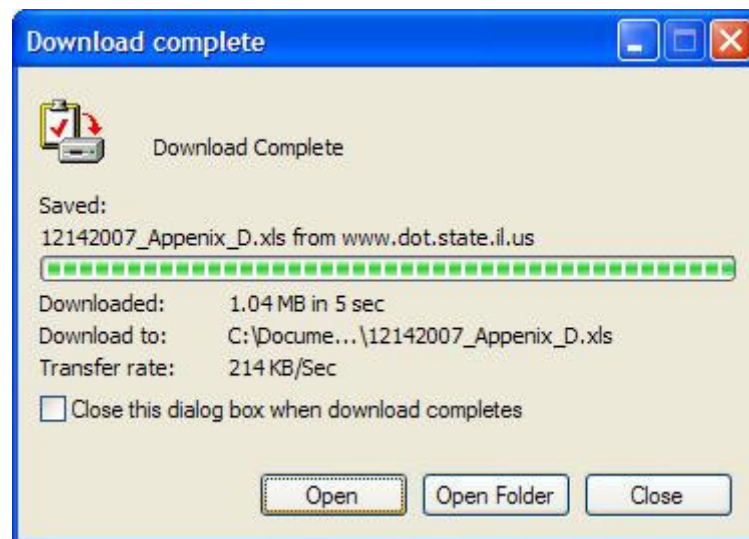
The tool will not work without downloading it and saving it into the computer prior its use. Try downloading the tool, and clicking the Save button



Select the desire location and an appropriate name to save the tool and click Save



After the download is completed, click Open, and the tool is ready to use.



When I open the tool I clicked on Disable Macros, and I cannot have the tool to work. Is there a way of changing this setting?

Yes. Close the tool without saving changes and try to reopen it again. This time make sure to click Enable Macros. This will solve the problem.

I accidentally saved the tool with the input data for my project inside. Is there a way to obtain the original tool without all the changes I made?

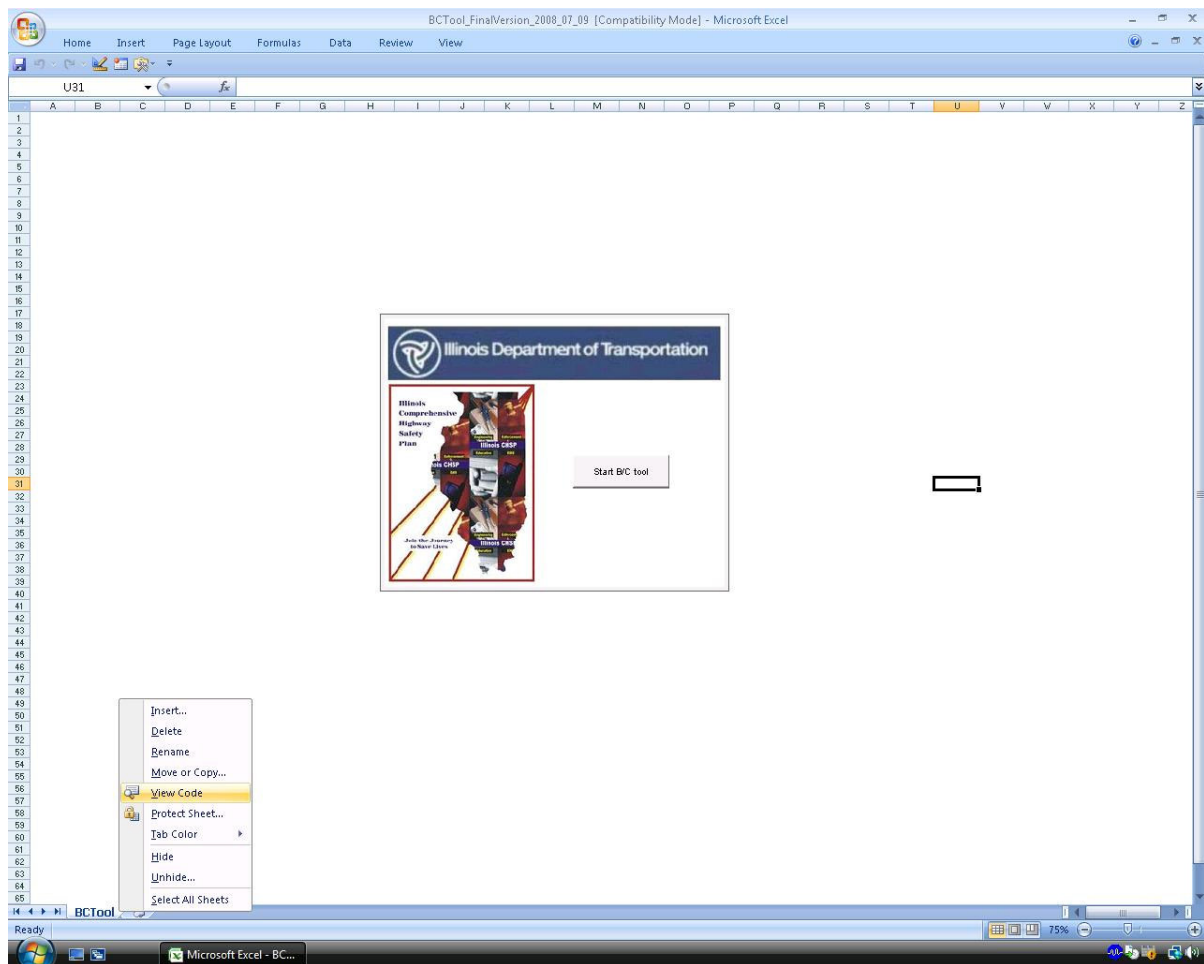
Yes. Go back to IDOT website (<http://www.dot.state.il.us/illinoisCHSP/hsip.html>) and download and save the tool again in your computer. If you want to save the information you input for a specific project, try using the option export data included in the tool under Output data

Troubleshooting Office 2007

I am getting the error message shown below. How can I fix it?



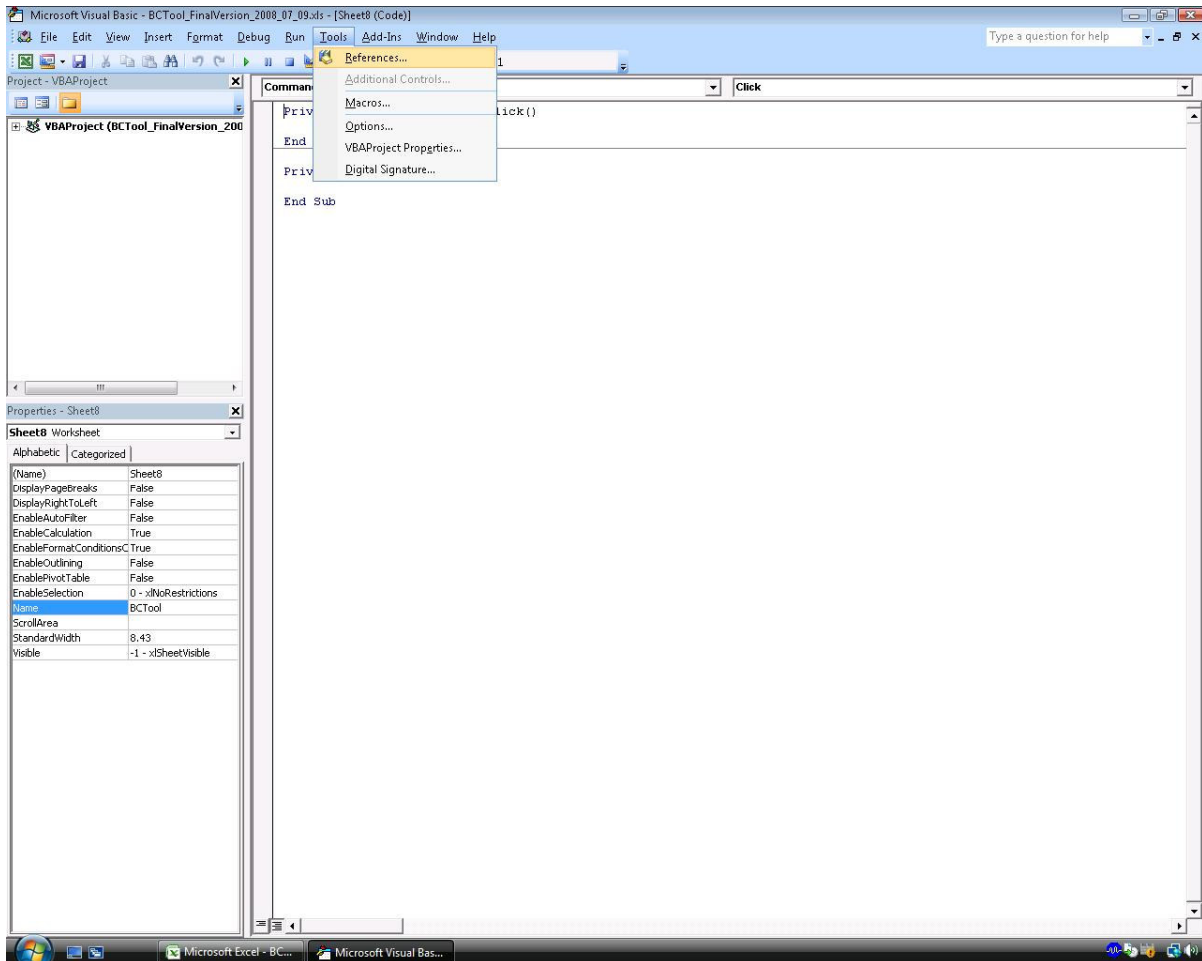
The first step to fix this error is to open the Visual Basic code. Close everything, and reopen the Benefit-Cost Tool. Right click on the BCTOOL tab located on the bottom left of the window. Select View Code from the pop up menu



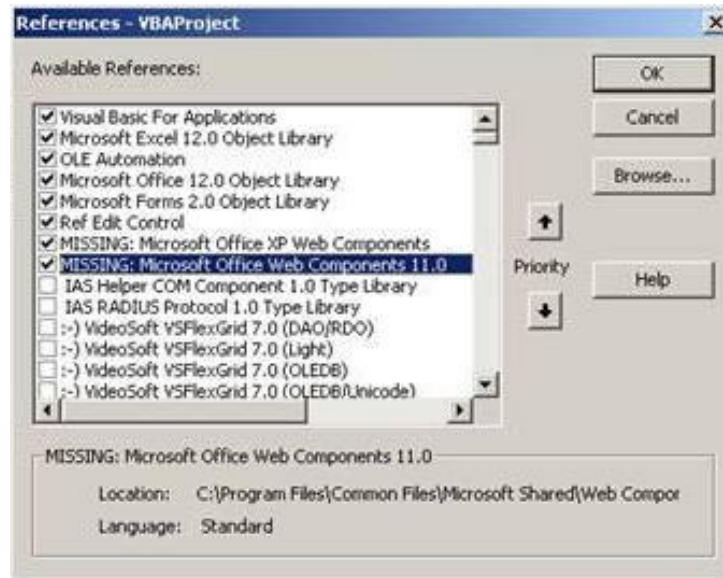
Since the tool is password protected, it is required to input the password (IDOTsafety) in the box shown below. Hit OK to continue. There are some files that are not protected, if you do not see the pop-up window shown below, ignore this step.



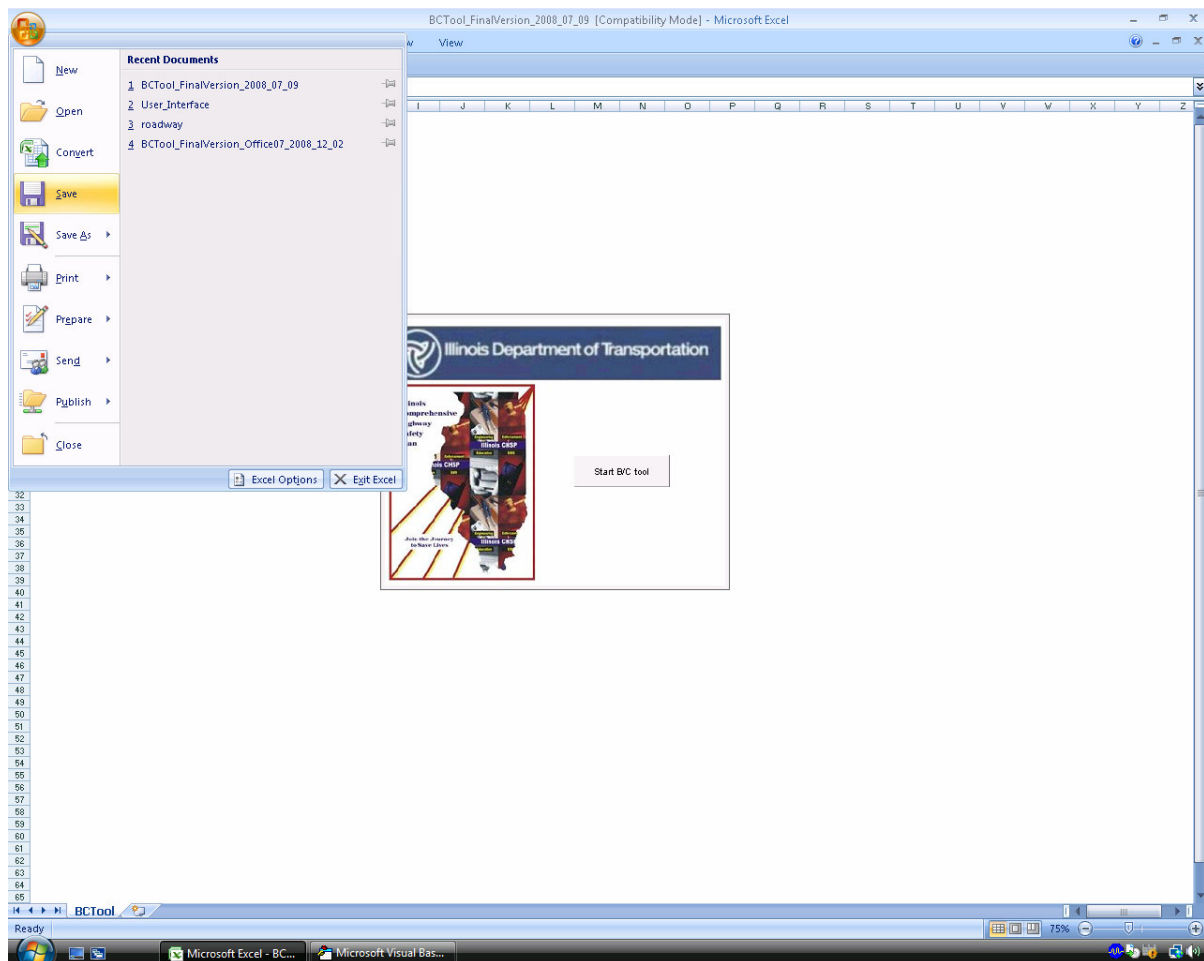
Select Tools – References from the top Microsoft Visual Basic toolbar



Look for the references “MISSING: Microsoft Office XP Web Components”, and “MISSING: Microsoft Office Web components 11.0” and unchecked the boxes. Hit OK to continue.



Go back to the Microsoft Excel window, and select the Office button-Save from the top left corner



Once the file is saved, go back to the Visual Basic window, and select File - Close and Return to Microsoft Excel. Now you can start using the Benefit Cost Tool.

